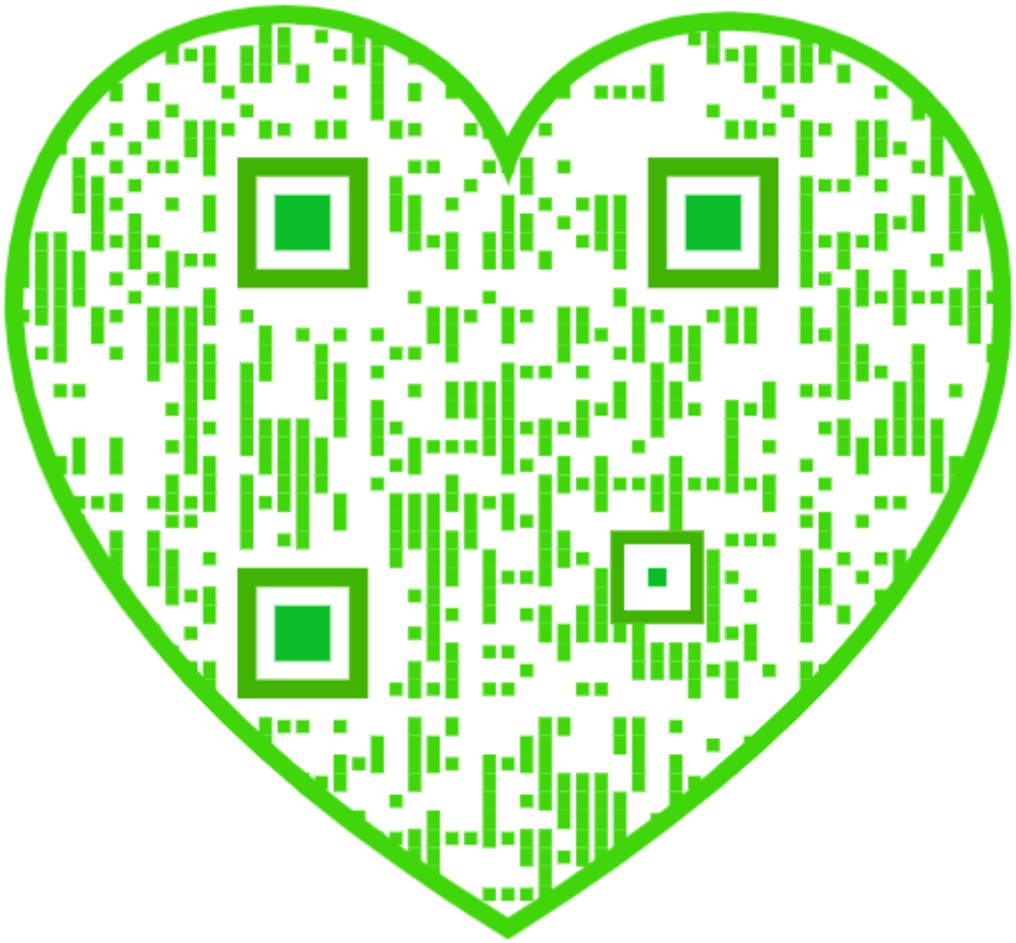

PRACTICAL
SHEET METAL WORK
AND
DEMONSTRATED PATTERNS

A COMPREHENSIVE TREATISE IN SEVERAL VOLUMES ON
SHOP AND OUTSIDE PRACTICE AND PATTERN DRAFTING

VOLUME IX
TIN SHOP AND FURNACE WORK

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COMPILED FROM THE
METAL WORKER
PLUMBER AND STEAM FITTER
EDITED BY
J. HENRY TESCHMACHER, JR.

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PREFACE

IN presenting this book—Volume Nine of the series of PRACTICAL SHEET METAL WORK AND DEMONSTRATED PATTERNS—one may question the wisdom of so doing, inasmuch as tinware is now practically all made by automatic machinery. Those who may so question are referred to the remarks of one of the contributors on page one. Supplementing those remarks it can be safely said, that even those who are engaged in the making of tinware by machinery, will find valuable assistance in this volume, especially in reference to drafting the patterns for the blanks prior to designing the dies for the cutting machines.

In the portion of the book devoted to furnace work many meritorious suggestions and much valuable information are presented. These are considered important, owing to the information on this subject being so meagre. Perhaps those possessing the information and the ability to express themselves in writing expend their time in compiling data on the engineering phase of furnace work, for an immense quantity of such material is available, which, of course, is extraneous to the scope of these series and can not be used.

The articles from which this book is compiled, have appeared in the columns of METAL WORKER, which carried on a campaign of enlightenment a short time ago, realizing that information of this sort is always valuable even though the old time "assortment ware" shops are nearly extinct.

As it was particularly desirable to thank those who had contributed, an extended investigation was necessary to learn who were the writers. It has been possible only to determine positively that William Neubecker and William Sanders were among them. To all, sincere thanks are expressed.

These series were made possible by reason of METAL WORKER having in its employ experts in the sheet metal trade and pattern drafting, and also constantly receiving data, shopkinks and the like from readers, and in the interests of wider dissemination of knowledge, its permission to place these articles in book form has been obtained.

J. HENRY TESCHMACHER, JR.

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Practical Sheet Metal Work and Demonstrated Patterns

SCHEDULE FOR HAND MADE TINWARE

It would seem, perhaps, that the use of hand made tinware was practically obsolete, since it has become so largely replaced to-day by machine made stamped goods. And yet the fact that there is, and probably always will be, more or less demand for this class of goods, especially in jobbing shops and the more remote country shops, shows the importance of knowing something of the sizes and dimensions of these articles.

The advantage of the schedules in vogue before the advent of machine made goods lies in the fact that they were gotten up with a special view of working material to the best advantage with the least possible waste. Another consideration that would seem to make the publication of these old but reliable schedules both desirable and important is the fact that "old Father Time" is fast thinning out the ranks of the "all around mechanic," and the field will soon be left to our young men growing up in the trade. If they understand the old and well tried methods of getting out the work, they will become better and more thorough mechanics, and hence more serviceable to their employers.

Schedule of Dimensions of 1-Pint, 3-Pint and 2-Quart Tin Basins.

	Dimensions in inches.			
		Depth on	*Diameter.*	
Size	*Depth*	*Flare*	*Top*	*Bottom*
1-pint	2¼	2⅜	5¾	4⅛
3-pint	2½	2⅝	8	6⅜
2-quart	3 15/32	3⅝	8½	6¼

One-Pint Basin.—The body made of two pieces, out of 10×14 tin.

Three-Pint Basin.—The body made in three pieces, cut out of 10×14 tin. Two pieces cut out of the width of the sheet 10 inches, and one piece one-half the long way of the sheet, or 7 inches.

Two-Quart Basin.—The body made in two pieces, out of a 10×14 sheet of tin and cut lengthways of the sheet.

Schedule of Dimensions of 6-Quart and 10-Quart Milk Pans.

	Dimensions in inches.			
		Depth on	Diameter.	
Size	Depth	Flare	Top	Bottom
6-quart	$3\frac{13}{32}$	$3\frac{3}{4}$	$11\frac{3}{4}$	$8\frac{3}{4}$
10-quart	$3\frac{13}{32}$	$3\frac{3}{4}$	$14\frac{1}{2}$	11

Six-Quart Pans.—The sides, or body of pan, are of four pieces of equal size, three pieces out of a 10×14 sheet of tin, cut crossways, or 10 inches width of sheet.

Ten-Quart Pans.—The sides, or body, are in four pieces, two pieces crossways of the sheet and two pieces lengthways of the sheet.

Schedule of Dimensions of Small and Large Dish Pans.

	Dimensions in inches.			
		Depth on	Diameter.	
Size	Depth	Flare	Top	Bottom
Small	$6\frac{1}{2}$	$6\frac{3}{4}$	14	10
Large	$7\frac{5}{8}$	8	18	13

Small Dish Pans.—The sides, or body, are made in five pieces of equal size out of 10×14 tin. Two pieces out of a sheet.

Large Dish Pans.—The body is made in four pieces of equal size, one piece out of a 10×14 sheet, cut lengthways of the sheet.

Schedule of Dimensions of 1-Quart and 2-Quart Dippers.

	Dimensions in inches.						Handles. Size of Patterns.		
Size of Dipper.	Depth	Depth on Flare.	Diameter Top	Diameter Bottom.	Top Diameter.	Bottom Diameter.	Length	Top Width.	Bottom Width.
1-quart.	$3\frac{7}{8}$	4	6	$4\frac{1}{8}$	1	$\frac{3}{4}$	9	$3\frac{3}{8}$	$2\frac{1}{2}$
2-quart.	$4\frac{7}{8}$	5	$7\frac{1}{2}$	$5\frac{1}{4}$	$1\frac{1}{2}$	$1\frac{1}{8}$	5	5	$3\frac{3}{4}$

One-Quart Dippers.—The body is made in two pieces of equal size, out of 10×14 tin, cut crossways of the sheet.

Two-Quart Dippers.—The body is made in two pieces of equal size, out of 12×12 tin.

PATTERNS FOR A DRINKING CUP

Fig. 1. A Tin Cup

There are many simple articles that can be made by the apprentice in the tin shop, with the ordinary tools. One of these is a plain drinking cup, such as is shown in Fig. 1. These are usually made from IC bright tin with a wire or hem edge at A. The bottom has a single edge and is soldered on the inside when hand made. Fig. 2 shows the three patterns for the cup. The pattern A, for the body, is cut on the squaring shears, of the required hight and in length equal to the circumference of the bottom, B. If the seam in the body is soldered, then only a single edge is necessary, as shown at *b*. If the seam is grooved, edges are allowed,

as shown at *a* and *b*. Should a wire or hem edge be allowed along the top of the cup, it should be notched at the corners, as shown. B shows the bottom with a single edge at *c*, while C D is the pattern for the handle, which is obtained by making C D equal to the length, and *d d* and *e e* equal to the top and bottom widths. The hem edges *f* and *f* are added. The body, A, is edged and wired, then rolled, the edge turned on the bottom B and then soldered to the body. The handle, C D, is then edged, formed to the required shape and soldered to the cup.

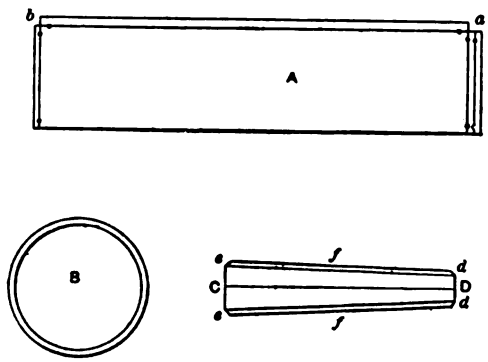


Fig. 2. The Patterns for the Cup

PATTERNS FOR REFRIGERATOR PAN

These pans can be made up in different sizes from No. 26 or 28 galvanized iron. A finished pan is shown in Fig. 3. The only difficulty in their construction is to obtain the pattern for the handles. In Fig. 4 a sectional view shows how the pan is constructed. B shows the bottom, with a single edge at C C slipped over the body and soldered on the inside. A A shows the wired edge, with the handles soldered or riveted at D and D. The pattern for the body is simply a straight strip of metal, to which allowance has been made for wiring. In length it is equal to the circumference of the bottom, allowing for seaming.

To obtain a true pattern for the handle, without which a lot of time is lost in trimming, proceed as is shown in Fig. 5. A B C shows a part elevation of the pan, a part plan of which is shown by D E, struck from the center F. Establish, at pleasure, the point 4″ in elevation, from which, at its proper angle and of the desired length, draw the line 4″ *b*. Extend 4″ *b* as 4″ 4. From 4 draw the perpendicular 4 *a*. With the desired radius, as 4 *a*, using *a* as center, describe the semicircle shown, which divide into equal spaces, shown from 1 to 4 to 1. Take a tracing of the profile 4 *a* and place it in plan on the center line F G, as shown by 4 *a*′. From points on profile and parallel to G F draw lines intersecting the body of the pan from 1′ to 4′. From these points erect vertical lines into the elevation, which intersect by lines drawn from similar numbered points in the profile A *a*, parallel to 4 4″, resulting in the intersections 1″, 2″, 3″ and 4″. Through these trace the miter line shown. Draw a line from *b* to 1″, which completes the side

view of the handle. From 1″, at right angles to 4″ *b*, draw 1″ *c*, on which line the profile 1 4 1 *a* is a section.

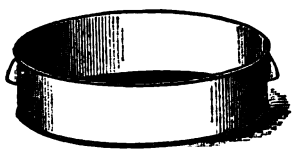


Fig. 3. Perspective View of Refrigerator Pan

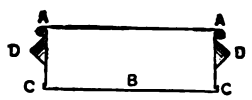


Fig. 4. Sectional View

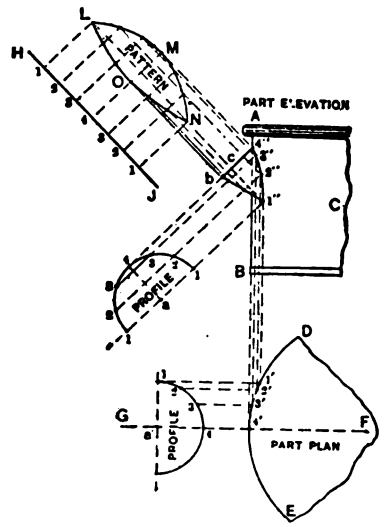


Fig. 5. Determining Pattern for Handle

For the pattern draw J H at right angles to 4 4″, upon which place the stretch-out of the profile 4 *a*. From these small figures, at right angles to H J, draw lines, which intersect by lines drawn at right angles to 4 4″ from similar points of intersections on *b* 1″ 4″. Trace a line through the points thus obtained, as L M N O, which is the desired pattern. Allow edges for riveting or soldering.

PATTERN FOR AN APPLE CORER

A useful little article that can be made from scrap tin, with all seams and joints soldered, is an apple corer. The full size dimensions and method of obtaining the pattern for the corer are shown in Fig. 6 and Fig. 7, in which A B C D is the side view of the corer, soldered to the handle E at the top, with an opening on the line C D, which forms the blade which cuts into the apple, while the opening 1′ 3′ 1″ allows the core to be taken out. The section through the corer is shown by F in plan. H I J K L shows the front view, K representing the circular blade, M the opening and N the joint. The round disks G and G at the ends of the handle are slightly convex, and assume that shape when using the hollow punch in punching the disks.

To obtain the pattern for the corer proceed as follows: Divide the half plan F into an equal number of spaces, as shown by the small figures 1 to 5. Parallel

to B C and from these small figures draw lines intersecting the blade line D C, the core opening at 1′, 2′, 3′, 2″ and 1″, and the handle E, as shown. Now at right angles to B C draw any line, as O P, upon which place twice the number of

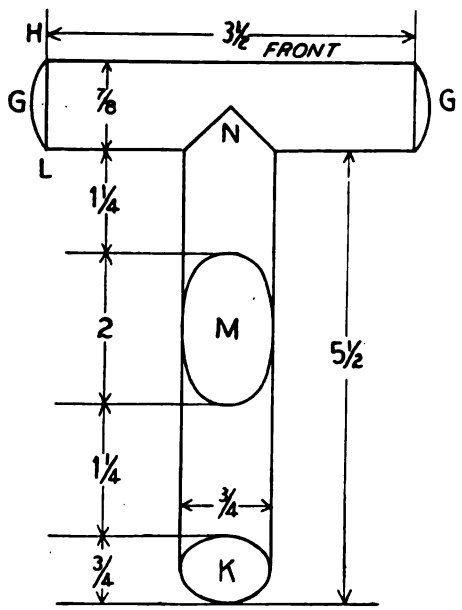


Fig. 6. Corer with Dimensions

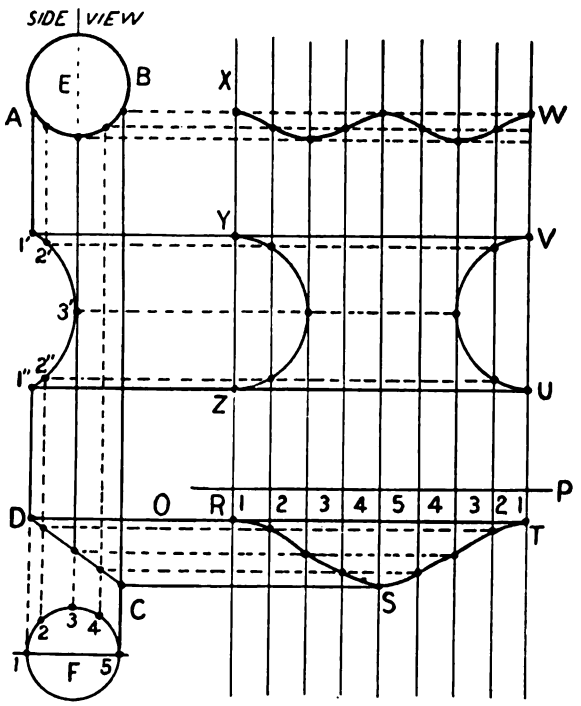


Fig. 7. Obtaining the Pattern

spaces contained in the half plan F, as shown by the small figures 1 to 5 to 1 on O P. Through these intersections and at right angles to O P draw lines indefinitely, as shown, which intersect with lines drawn from points of intersections on D C, 1′ 2′ 3′ 2″ 1″, and on A B having similar numbers, as shown in the pattern. A line traced through points of intersection thus obtained, as shown by R S T U V W X Y Z, will be the pattern for the corer. The pattern for the handle is not shown, as that simply consists of a tube as long as from H to I in front, with a diameter equal to E in side view, having the convex disks soldered on same to close the ends.

PATTERN FOR SCALE SCOOP

A finished view of a scale scoop is shown in Fig. 8, where the top edge is wired and the joint either seamed or soldered. While the pattern can be obtained by the cone or radial line method, a simpler rule is shown in Fig. 9, by which the pattern is developed by means of the parallel line method.

First draw the elevation of the scoop, as shown by A B C D. In practice one-half elevation is all that is required. From the point B, at right angles to D C, draw the line B E, on which line a true section must be obtained, as follows: Extend the line D C as D F. Parallel to D F, and from B draw the line B G. At any point, as H, at right angles to B G, draw the line H I, which represents the depth of the scoop. At pleasure establish the width of the scoop at the top, as shown by K and L. Draw a line from K to I, which bisect and obtain the point T. From T, at right angles to K I, draw a line intersecting the center line H I at J. With J as center and J K as radius describe the arc K I L, which represents the true section on the line B E in the elevation.

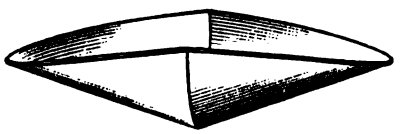


Fig. 8. Perspective View

Divide the section into equal parts, as shown by the small figures 1 to 4 to 1, through which, parallel to G B, draw lines into the elevation, intersecting the lines B C and B D at points 1 to 4, as shown. Now, at right angles to D C draw the stretchout line M N, upon which place the stretchout of the true section, as shown by points 1 to 4 to 1 on M N; through which, at right angles to M N, draw lines, which intersect with lines drawn at right angles to D C from similar numbered intersections on B C and C D. A line traced through the points thus obtained, as shown by M O N P, will be the half pattern of the scale scoop. Allowance must be made for wiring and seaming.

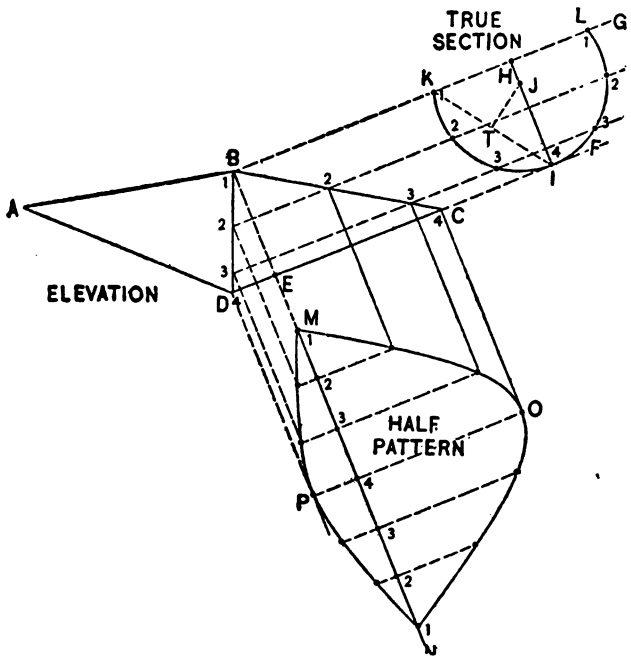


Fig. 9. Elevation, Section and Pattern

PATTERNS FOR HAND SCOOP

A finished or perspective view of a grocer's hand scoop, which is a piece of tinware usually made by hand in the tin shop, is shown herewith in Fig. 10.

When carefully designed it presents a neat appearance, especially when made of bright tin or polished brass. The scoop contains three patterns, shown by A, B and C. The body, A, is seamed at *a*; the flat bottom in the back of the scoop is seamed to the body at *b*, and a small button is seamed to the handle B at *c*. The handle could, if so desired, be made tapering with very little additional labor in the developing of the pattern.

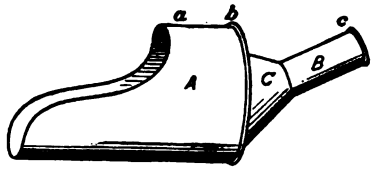


Fig. 10. Perspective View of Hand Scoop

The method of laying out the patterns is shown in Fig. 11, in which A B C D represents the side view of the scoop, care being taken to draw a graceful curve, A D. In its proper position draw the section or diameter the scoop is to have, as shown by E F G H, which divide into equal spaces, as shown by the small figures 1 to 7 on either side. Through these small figures, parallel to D C, draw lines intersecting the curve A D, as shown. For the pattern for the scoop, in line with B C draw the line C J, upon which place the stretchout of the section E F G H, as shown by the small figures 1′ to 7′ to 1′ on C J. Through these small figures, at right angles to C J,

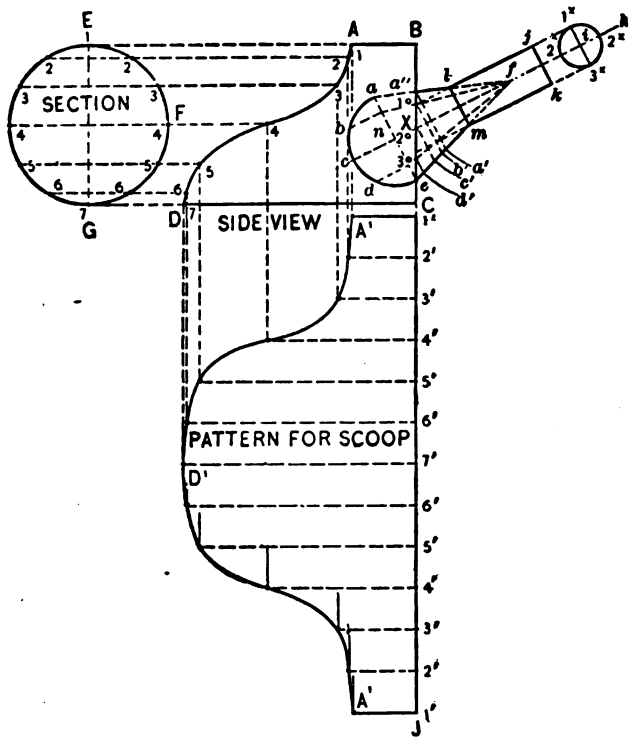


Fig. 11. Side View, Sections and Patterns

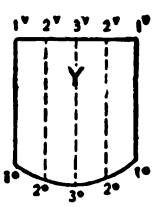


Fig. 12. Pattern for Handle

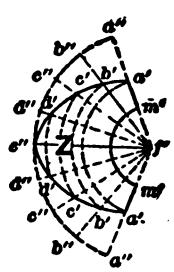


Fig. 13. Pattern for Conical Boss

draw lines, as shown, which intersect with lines drawn from similar numbered points on A D at right angles to D C. Trace a line through these points, as

shown. Then will 1′ A^1 D^1 A^1 1′ be the net pattern for the scoop. The pattern for the back of the scoop B C is shown by the section E F G H, to which laps must be allowed for seaming.

For the pattern for the handle, B in Fig. 10, proceed as is shown in Fig. 11. First locate the point X on the line B C, where the center of the handle will strike, and, at its proper angle, draw a line through X, as shown by *c h*. With any point, as *i*, as center, on the line *c h*, draw the profile of the handle, as shown by 1^x 2^x 3^x 2^x. From 1^x and 3^x, parallel to the center line *h c*, draw the lines 1^x 1° and 3^x 3°, intersecting the line B C at 1° and 3°. Establish the length of the handle, as *j k*, which line draw at right angles to *h c*. Now divide the profile *i* into an equal number of spaces, as shown by the small figures 1^x 2^x 3^x 2^x. (In practice more spaces must be used.) Through these small figures, parallel to the lines of the handle, draw lines intersecting the line B C at 1°, 2° and 3°.

For the pattern, draw any horizontal line, as 1^v 1^v in diagram Y, Fig. 12, upon which place the stretchout of the profile *i* of the handle, as shown by similar numbers on 1^v 1^v. From these points, at right angles to 1^v 1^v, draw lines indefinitely, as shown. Measuring from the line *j k* in the side view, Fig. 11, take the various lengths to 1°, 2° and 3°, and place them on lines having similar numbers in diagram Y, measuring from the line 1^v 1^v, thus obtaining the intersections 1° 2° 3° 2° 1°. A line traced through the points thus obtained, as shown by Y, will be the net pattern for the handle.

For the pattern for the conical boss C in Fig. 10 proceed as is shown in Fig. 11. First locate the top of the boss *l m* in the side view, which is drawn at right angles to the center line *h c*. Then locate the point *e* on B C at pleasure, and extend the line *e m* until it meets the center line at *f*. From *f* draw a line through *l* intersecting the line B C at A″, and meeting the line drawn from *e* at right angles to the center line *h c* at *a*. Then will *a e m l* represent a frustum of a right cone intersected by the line *e a″*. Using *n*, the intersection between the line *e a* and *h c*, as center and *n a* or *n e* as radius, describe the arc *e c a*, which divide into equal spaces, as shown by the small letters *a b c d e*, from which points, at right angles to *a e*, draw lines intersecting the base line *a e*, as shown. From the intersections on *a e* draw lines to the apex *f* intersecting the line B C, as shown by the small dots, from which, at right angles to *h c*, draw lines intersecting the side of the cone *m e* at *a′*, *b′*, *c′*, *d′* and *e*.

For the pattern take *f e* as radius and *f′* in diagram Z, Fig. 13, as center, and describe the arc *a″ a″*, upon which, starting from *a″*, lay off the stretchout of twice the number of spaces contained in the semicircle *a c e* in the side view, Fig. 11, as

shown by similar letters on the arc a'' a'' in diagram Z, Fig. 13. From these points draw lines to the apex f', which intersect with arcs struck from f' as center and radii equal to f a', b', c', d' and e, thus obtaining intersections having similar letters in diagram Z. With f m in the side view, Fig. 11, as radius, and f' in Z, Fig. 13, as center, describe the arc m' m' intersecting the radial lines a'' f'' at m' on either side. Then will m' a' e'' a' m' be the net pattern for the conical boss.

An article, known as a "Thumb Scoop," of small size used generally to handle such stuff as spices, and which has just an ordinary tin drinking cup handle, can be laid out by the above principles.

PATTERNS FOR CLOTHES SPRINKLER

In Fig. 14 is shown a finished view of a clothes sprinkler, used to dampen clothes before ironing. This sprinkler can be made from IX tin about 4 in. in diameter and about 5 in. high. It is filled with water by opening the screw top A; which is purchased, made from zinc.

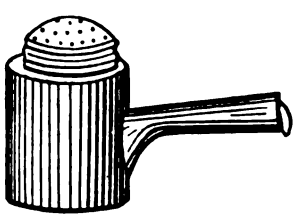


Fig. 14. Finished Article

The method of construction and of obtaining the various patterns is shown in Fig. 15, in which A shows the body of the screw top, edged and soldered to the body of the can at C, or if desired, it may be double seamed and soldered; while B shows the sprinkler top which can be unscrewed from the body A. The bottom is edged and soldered to the body at D. The pattern for the body is simply a rectangular piece the length of which is equal to the circumference of the bottom and of a width equal to the hight C D.

The pattern for the handle E is obtained by extending its sides until they intersect at H, which becomes the center point from which to strike the pattern, using as radii H F and H T and describing the pattern J K L M, the girth of the circle G being placed along the arc J K, allowing a lap at e for soldering.

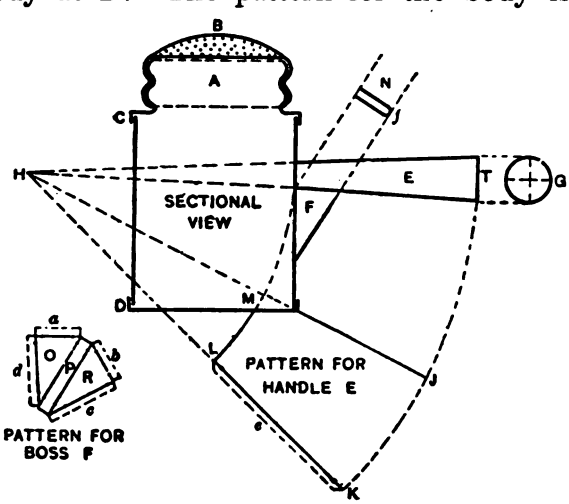


Fig. 15. Vertical Section Through Sprinkler

While the intersection between the handle E and body M presents a problem of a cone intersecting a cylinder, it has been assumed that the handle or cone E is intersected by the plane F, which answers for all practical purposes, when the diameter of the handle is small and that of the body large. The boss F, the section of which is shown at N, is developed by taking a reproduction of F and placing it as shown at O. The distance P is now placed perpendicular to O equal to the girth of the curve *f* in N, and then O traced to the opposite side, as indicated by R. Edges are allowed for soldering purposes as shown by *a b c* and *d*. A button is edged or soldered to the handle at T.

PATTERN FOR STRAINER

For a strainer to fit in the bottom of a tank, in Fig. 16 is shown the article, in which A B is the part bottom of the tank and 5′ 1 5 the plan view of the strainer. A^1 B^1 in front elevation shows the horizontal plane of A B in plan,

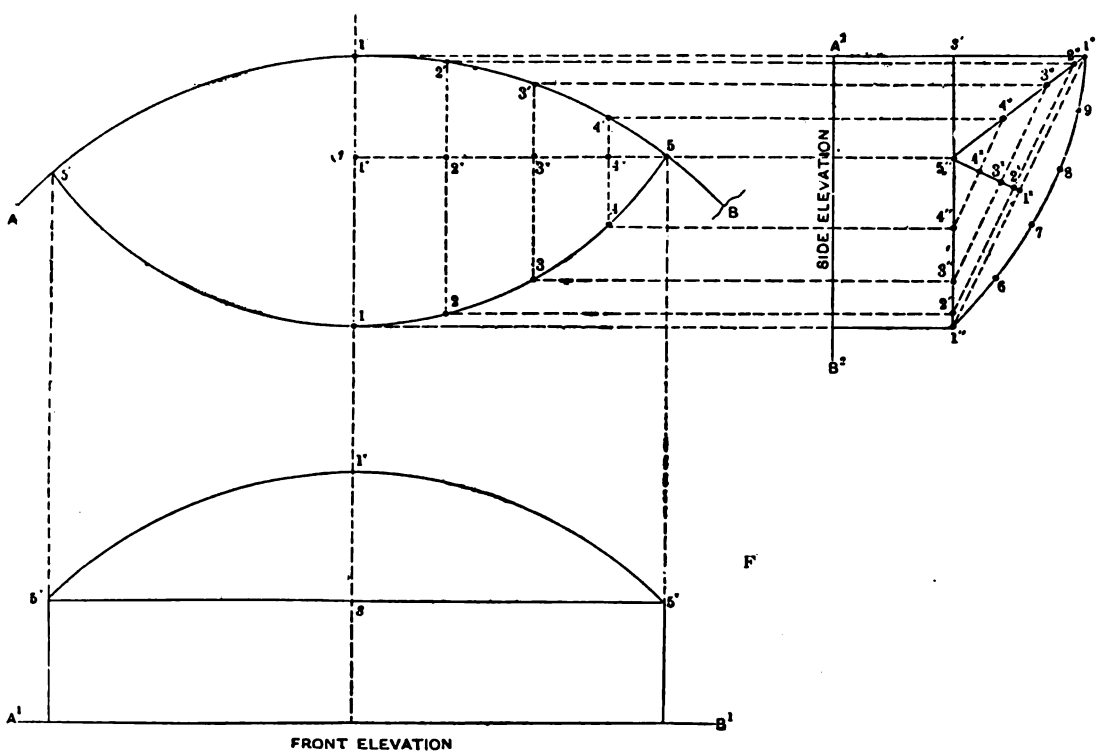


Fig. 16. Plan and Elevation of Strainer

while 5^v 5^v in elevation shows the horizontal plane of 5′ 5 in plan. 1^v in elevation shows the rise of the strainer at 1′ in plan. In the side elevation A^2 B^2 is the

plane on A B in plan and s 1″ the plane on 5′ 5 in plan. s' 1° is equal to s 1^v in front elevation. The strainer must be "raised" to have the shape as shown by 5^v 1^v 5^v in front and 1° 1″ in side. In obtaining the pattern for that part of the strainer shown by A^1 B^1 5^v 5^v in front elevation, all that is required is to cut a strip of metal with a hight equal to A^1 5^v and a length equal to 5′ 1 5 in plan.

In obtaining the pattern for the top or raised portion, assume that 1° 1″ in side elevation is straight, and then when the pattern is developed add the difference between the straight line 1° 1″ and the curved line 1° 8 1″, as shown between 1° and X in Fig. 18. For the pattern proceed as follows: As both halves of the strainer are symmetrical, divide the curve of the strainer shown from 1 to 5 in plan in Fig. 16, as shown by 1, 2, 3, 4 and 5. From these points parallel to the center line draw lines intersecting the curve of the tank at 1′, 2′, 3′ and 4′. From 5, at right angles to 1 1′ draw the line 5 r intersecting the previously drawn lines at 1^v, 2^v, 3^v and 4^v. From the various points 1 to 5 parallel to r 5 draw lines cutting the line s' 1″ in side elevation at 1″, 2″, 3″, 4″ and 5″, from which points parallel to the line drawn from 1″ to 1° draw lines indefinitely until they intersect lines drawn from the intersections 1′ 2′, 3′ and 4′ in plan, resulting in the intersections 1°, 2°, 3°, 4° and 5″ in side elevation. A line traced through these points shows the line of joint between the strainer and side of tank.

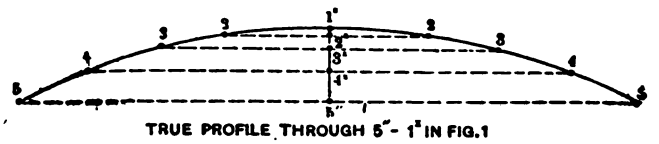


Fig. 17. Method of Finding True Profile

From 5″, at right angles to 1° 1″, draw the line 5″ 1^x intersecting lines at 2^x, 3^x and 4^x. Take the distance of 1^x 5″ with the various intersections on same and place it in a vertical position, as shown by similar numbers in Fig. 17, through which draw horizontal lines indefinitely, as shown. Measuring from the line 1′ 1 in plan in Fig. 16, take the various distances to 2^v, 3^v, 4^v and 5 and place them on lines having similar numbers in Fig. 17, measuring on either side of the line 1^x 5″. A line traced through points thus obtained, as shown from 5 to 1^x to 5, will be the true profile through 5″ 1^x in side elevation in Fig. 16.

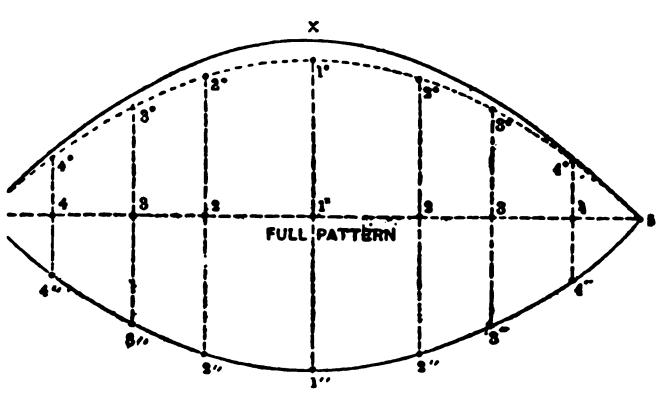


Fig. 18. Pattern for the Strainer

In Fig. 18 draw any horizontal line, as 5 5, upon which place the stretchout of 5 1^x 5 in Fig. 17, as shown by similar figures in Fig. 18, through which points draw vertical lines as shown. Measuring from the line 5″ 1^x in side elevation in Fig. 16, take the various distances to points 1″ to 5″ and to points 1° to 4° and place them in Fig. 18 on either side of the line 5 5, as shown by similar figures. Trace a line through points thus obtained, then will 5 1″ 5 1° 5 be the pattern, if the strainer was straight on the top, as shown by the line 1° 1″ in side elevation in Fig. 16.

As the cut shown from 5 to 1″ to 5 in Fig. 18 is the correct cut to fit on 5′ 1 5 in plan in Fig. 16, take the girth of the curve in side elevation shown by the small figures 1″ to 6 to 7 to 8 to 9 to 1° and place it from 1″ to X in Fig. 18, and draw the curved line 5 to X to 5. Then 5 X 5 1″ 5 is the desired pattern, which must be raised to the shape shown by 5′ 1 5 in plan in Fig. 16 and the curve 1° 1″ in the side elevation.

PATTERNS FOR A SCALE SCOOP AND STAND

In the lower left-hand corner of the diagram, Fig. 19, is an elevation drawn to scale giving dimensions of a scale scoop 13 in. wide and its stand. The problem is to assume that the scoop must be made in two parts with a seam on the line C D. It then becomes self-evident that the half portion of the scoop is a part of a body of, say, a cylindrical surface, and a section of it may be taken on the line A B perpendicular to the elements of the cylindrical surface. The top lines and the line C D are assumed as the edge lines of planes cutting this surface. To term the surface cylindrical is not to limit it to a cylinder as commonly understood, with circular base, but as a surface generated by a straight line moving always parallel to itself.

The half portion of the scoop is reproduced full size, as delineated in the lower half of the diagram, with the line A B in a vertical position to facilitate development. As the process is governed by certain dimensions, the section on A B cannot be granted as a part of a cylinder with a circular base or cross section, but an arbitrary section is drawn to the left of the scoop and adhering to the width given, the depth now being governed by the line A B, as shown. This is one-half of the section, the full section not being necessary.

This section is divided into convenient spaces, and lines drawn to the line C D and to the top line of scoop; in other words, the edges of the cutting planes already mentioned. Continuing the line A B as a stretchout line, the girth of the

section is placed thereon; the usual lines drawn through the points on this line and intersected by lines from the elevation, all as indicated. A line traced through the points of intersection is the desired one-half pattern.

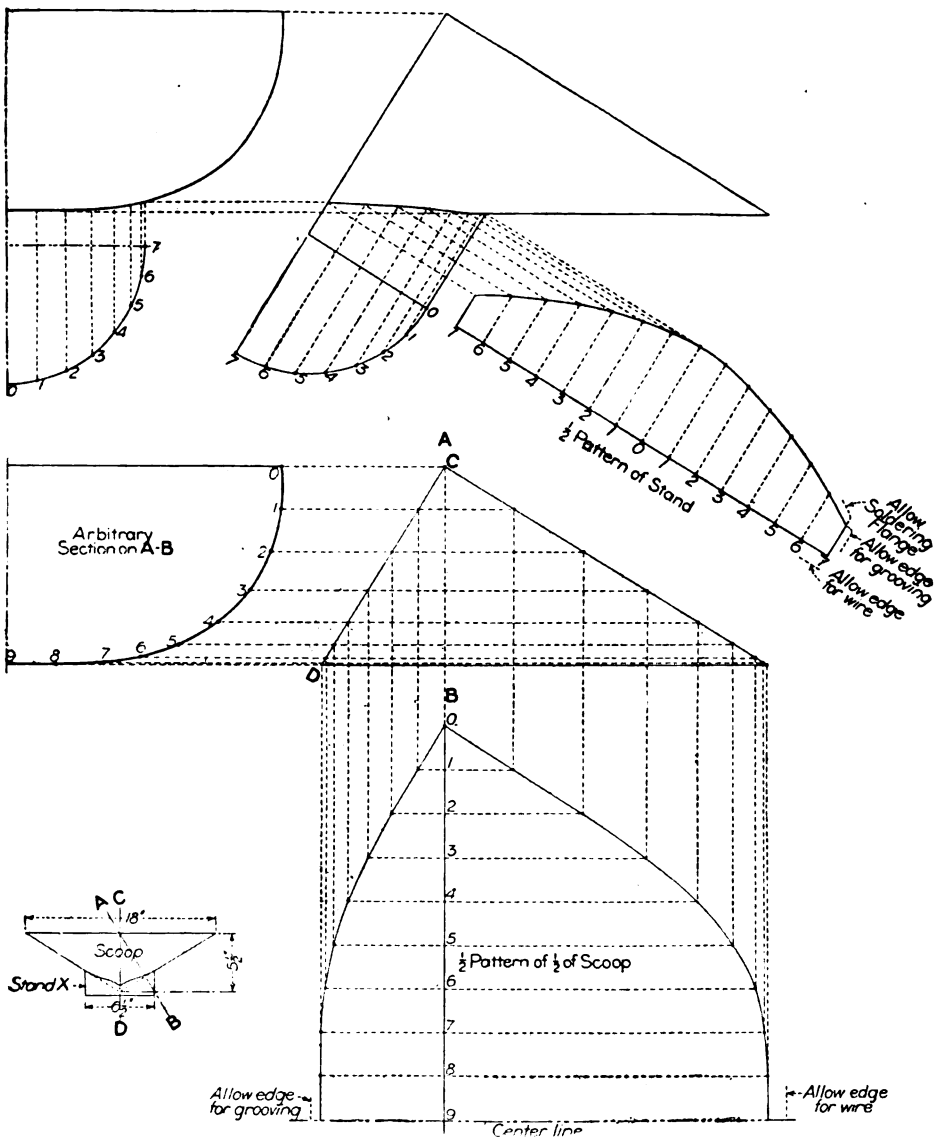


Fig. 19. Pattern for Scale Scoop and Base

It was presumed that the stand should be a cylinder, as the customary platform of a scale is round. The cylinder is, therefore, made of a size large enough to insure stability to the scoop when loaded, and at the same time not too big to slip over, instead of resting on the scales platform. A reproduction is made of the half elevation of the scoop and the section in its relative position. The elevation is placed with the top line horizontal, which allows using the T-square to develop miter line

and pattern, but to economize space and for appearance it is turned in the engraving, as shown at the top of diagram.

The intersection of the stand with the scoop, or the miter line of the cylinder, is developed by drawing a quarter circle of the stand under the section of the scoop; the center line of this quarter circle being coincident with that of the center line of the section. This quarter section is divided into equal parts and lines projected to the section and from there to the elevation, to be, in turn, intersected by lines drawn from a quarter circle placed in proper position under the elevation, as shown, or as called for by the small scale drawing.

As these points of intersection are the miter line, so to speak, a stretchout of one-half the stand is drawn, as shown by 7 to 0 to 7, and the customary measuring lines intersected by lines from the miter line, resulting in one-half the pattern of the stand.

PATTERN FOR A SAND SPRINKLER

A sand sprinkler, such as is used by painters to imitate stone by sprinkling sand on painted work, and which can be made by the tinner from tin plate or zinc, is shown herewith in Fig. 20. In this illustration A represents the body, B the perforated sprinkler, C C a zinc can screw, which may be bought from dealers in tinners' trimmings, and D a conical boss, which makes rigid the handle E, onto which the button F is soldered. In Fig. 21 is given the method of construction and the location of the joints, the cut being lettered to correspond with Fig. 20.

The method of laying out the patterns is shown in Fig. 22. First draw the side elevation of the article, in which A B C D shows the body, E the zinc screw, F G H I the handle and J L M K the boss. For the pattern for the body use E as center and describe the half section through the body, as 1 3 5, which divide into equal parts, as shown by the small figures 1 2 3 4 5. Through these points, parallel to A B, draw lines intersecting the face line A D. In line with B C draw the line C P, upon which place twice the number of spaces contained in 1 3 5, as shown from 5 to 1 to 5 on C P. At right angles to C P and through the small figures draw lines, which intersect by lines drawn at right angles to A B from similar intersections on A D. Trace a line through the points thus obtained; then will S R 5 5 be the pattern for the body.

For the pattern for the face, shown in elevation by A D, draw lines at right angles to and from the various intersections on A D, as shown. Parallel to A

D draw N O. Measuring in every instance from the line B C, take the various distances to points 2, 3 and 4 on the curve 1 3 5 and place them on corresponding lines, measuring in each instance from the line N O on both sides, thus obtaining the points 1′, 2′, 3′, 4′ and 5′. Through these intersections trace an ellipse, as shown, in which punch the required holes.

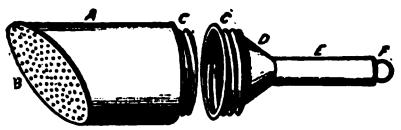


Fig. 20 Perspective View of Finished Article

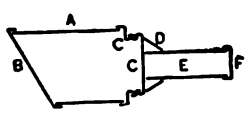


Fig. 21. Showing the Location of the Joints

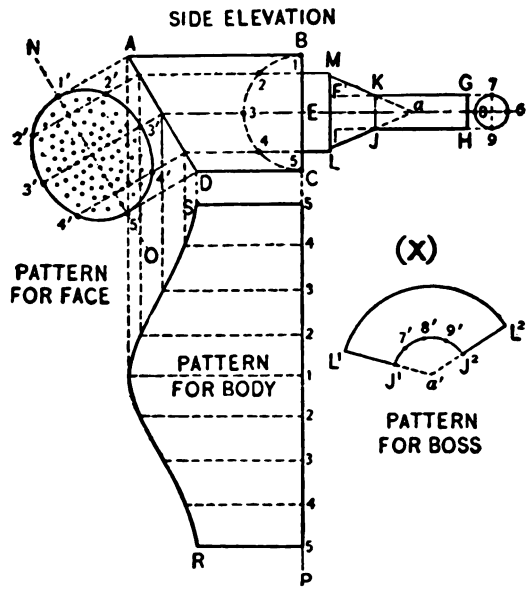


Fig. 22. Side Elevation and Patterns

The pattern for the handle F G H I will be as long as F G, and as wide as the circumference of the section 6 7 8 9. The pattern for the button G H is shown by 6 7 8 9. For the pattern for the conical boss, extend the lines L J and M K until they intersect the center line at a. Then, with radii equal to a J and a L, and with a' in (X) as center, describe the arcs J^1 J^2 and L^1 L^2. From L^1 draw a line to the center a', intersecting the inner arc at J^1. Starting from J^1, lay off the stretchout of 6 7 8 9 in side elevation, as shown by J^1 7′ 8′ 9′ J^2 on the arc J^1 J^2 in (X). Draw a line from a' through J^2 intersecting the outer arc at L^2. Then will L^1 L^2 J^2 J^1 be the pattern for the conical boss. The parts are thus all obtained, and all that now remains to be done is to put them together and solder the joints.

By making the handle tapering a better assurance is made of a firm hold for the hand of the operator. This handle would be simply the frustum of a cone and laid out accordingly, the wide end being at G H of Fig. 22, and the same width as now shown is to be maintained at K J, so that the boss as here given would do for this kind of a handle.

PATTERNS FOR FLOUR SIFTER

In Fig. 23 is shown a finished view of a flour sifter, usually made from IC bright tin plate. The handle A, which is fastened to the body, is further strengthened by the conical boss B. C shows the wire handle which operates the beaters when the flour is to be sifted through the wire cloth sack on the inside of the body. Knowing the size of the sifter, first draw the elevation of the body of the sifter, as shown by A B C D in Fig. 24. Directly below it, in its proper position, draw the plan, as shown by E F G H. Midway between B and C in the elevation draw the handle I J, shown in plan by K L. Now draw M N in elevation, which represents the wire handle, made from ⅛-inch thick wire, which passes through the button on the end of the handle and through the two sides of the body, as shown. The wire handle is shown in plan by O E, and is fastened in position by the washers at *a* and *b*. A small knob fastened to the end of the wire handle is shown at *f*, while P shows the button double seamed to the tin handle at *c*, and R S the conical boss between the handle and the body.

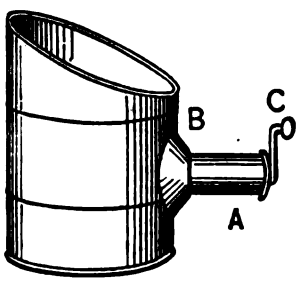


Fig. 23. Perspective View of Flour Sifter

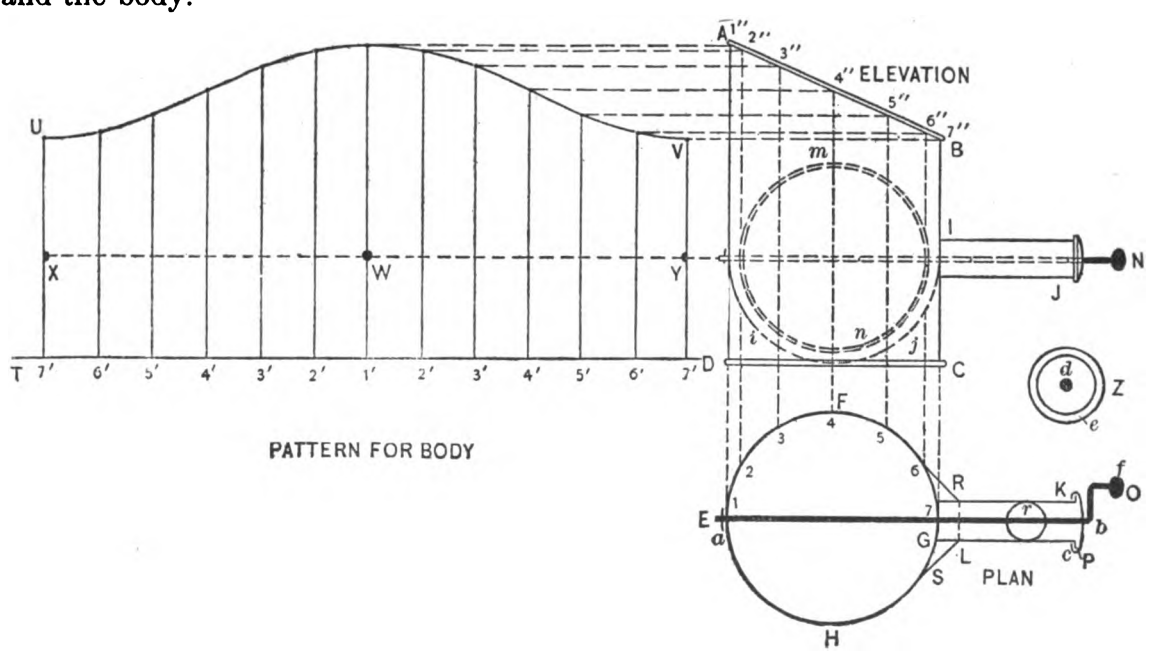


Fig. 24. Plan, Elevation, and Pattern for Body

As both halves of the body are symmetrical, divide the half plan E F G into an equal number of spaces, as shown by the small figures 1 to 7, from which erect vertical lines intersecting the top and bottom of the body in elevation, as shown.

In line with C D draw the line D T, upon which place twice the number of spaces contained in the half plan, as shown by similar figures on D T. At right angles to D T and from these small figures draw lines, which intersect with lines drawn from similar numbers on A B at right angles to A D. Trace a line through the points thus obtained. Then will U V D T be the pattern for the body of the sifter. It will be noticed that the pattern is obtained below and above the wire lines on top and bottom of the body respectively, and for that reason allowance must be made to the net pattern shown. The small dots X, W, Y represent small holes to be punched into the pattern to admit the wire handle N M, and are obtained by projecting a line from M, intersecting the center and ends of the pattern as shown.

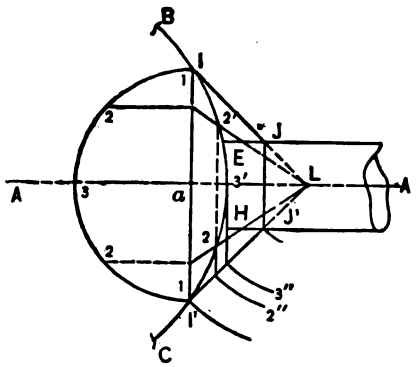


Fig. 25. Enlarged View of Boss

While the pattern for the handle K L in plan or I J in elevation presents a problem of two cylinders of unequal diameters intersecting each other at a right angle, assume that 7 G in plan is a flat surface and make the pattern in length equal to K 7 and in width equal to the circumference of the circle *r*, to which laps must be allowed for soldering. This pattern will answer for all practical purposes where the body is of so large, and the hand of so small, a diameter.

The pattern for the button P is shown at Z, *d* representing the hole punched to admit the wire handle, and *e* the edge to the double seam on the handle K L at *c*. For the pattern for the conical boss, R S, joining the round body of the sifter, proceed as is shown in Fig. 25, which is an enlarged view to clearly show each step taken. First draw the center line A A^1, and from A as center draw a portion of the body, as shown by B C. Then draw a portion of the handle E F G H and establish at pleasure the pitch at the boss I J and I^1 J^1. Extend these lines, intersecting the center line A A^1 at L. Draw a line from I to I^1, intersecting the center line at *a*. Using *a* as center and *a* I as radius, describe the half-section of the boss on the line I I^1, as shown by 1 3 1. Divide this half-section into equal spaces, as shown by the small figures 1, 2, 3, 2, 1, from which points, at right angles to 1 1, draw lines intersecting the base lines 1 1, as shown. From these points draw lines to the apex L, intersecting the body of the sifter B C at 1, 2′, 3′, 2′, 1. From these intersections, at right angles to the center line A A^1, draw lines intersecting the side of the boss at 1 2″ 3″. Now, with radius equal to L I, and L in Fig. 26 as center, describe the arc 1 1‴, upon which place the stretchout of

twice the number of spaces contained in the half section 1 3 1 in Fig. 25, as shown, by similar number on 1 1‴ in Fig. 26. From these points draw radial lines to the center L, as shown. With radii equal to L 2″ and L 3″ in Fig. 25, and with L in Fig. 26 as center, draw arcs intersecting radial lines having similar numbers, as

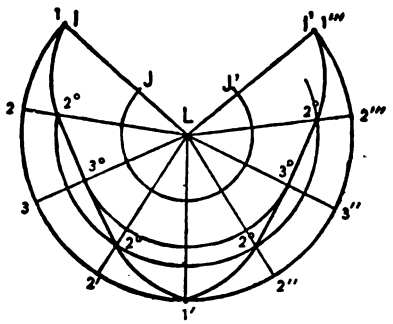


Fig. 26. Pattern for Conical Boss

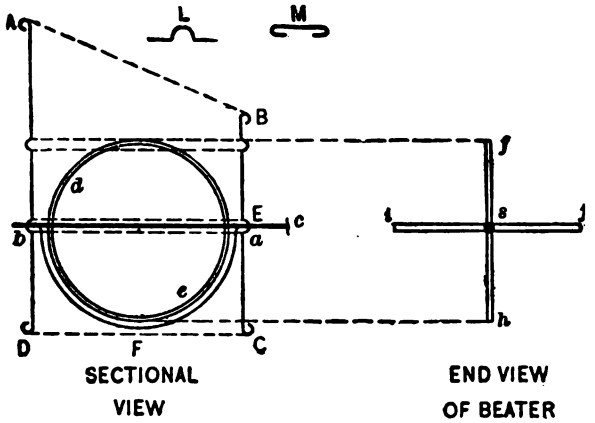


Fig. 27. End and Sectional Views

shown by the intersections 2°, 3°, 2°, 2°, 3°, 2°. In a similar manner, with radius equal to L J^1 in Fig. 25 and L in Fig. 26 as center, draw the arc J J^1, intersecting the radial lines drawn from 1 and 1‴. Trace a line through the points thus obtained; then will I 1′ I^1 J^1 J be the pattern for the conical boss.

In Fig. 27 is shown the construction of the beater and wire cloth sack. A B C D represents the sectional view of the body with a bead turned out at D and E. The bead E should be placed at a distance from the bottom equal to the half diameter of the body. A circle of fine wire cloth is now cut equal in diameter to the stretchout of the half circle *b* F *a*, and then formed into the shape of a half sphere with an edge turned out slightly at the top, as shown at *a* and *b*, and tacked with solder around the bead E. Two strips of tin are now edged or beaded, as shown at M or L respectively (which is full size) and equal in length to the circumference of the circle *d e* (which is slightly smaller than the half sphere F, to allow it to turn easily), and rolled up and soldered. Then the two rings are joined together at right angles to each other, as shown in the end view of beater at *h f* and *i j*. A hole is punched through the center, as shown at *s*, to admit the wire handle. The ring beaters are now placed in the body, as shown by *d e*, and the handle *c* passed through the tin handle, body and rings. The rings are now soldered firmly to the tinned wire and the washers soldered to the handle on the outside, the beater then being ready for use. If the sifter is of large size, three or four rings can be used for the beater.

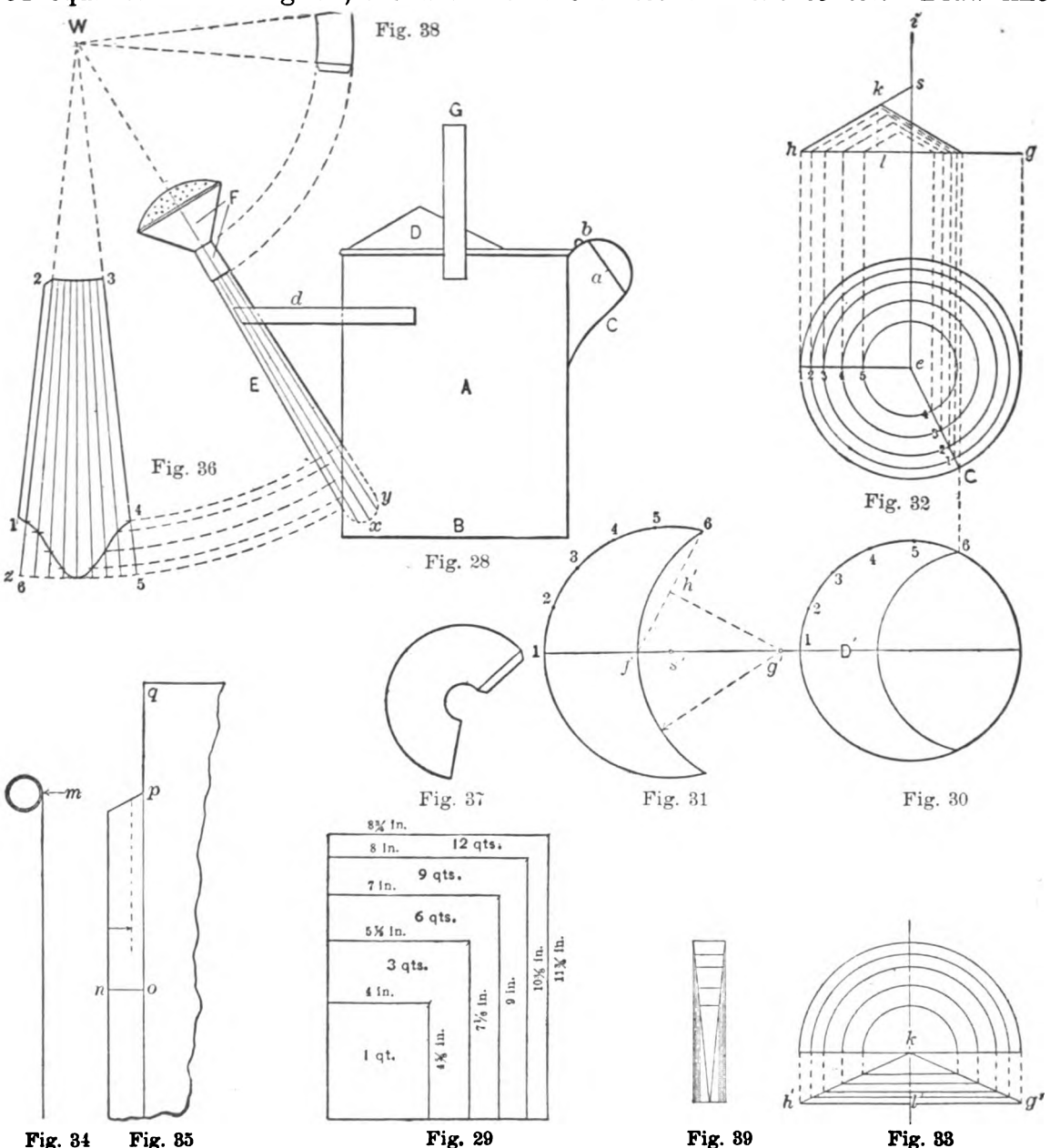
WATERING POTS, PROPORTIONS AND PATTERNS

In Fig. 28 a watering pot is shown composed of various parts. A shows the body of the watering pot, B the bottom, C the rear handle, D the crescent shape water guard, E the spout, F the sprinkler, G the bail or handle on top, *a* is the boss in rear handle, *d* is the brace, one on each side of the spout E used on the large sizes, from 6 to 12 quarts, for strengthening the connection of the spout E with the body of the watering pot.

Before a watering pot of any special size can be made, its hight and diameter must be known, and three and one-seventh times the diameter gives the circumference or stretchout of the body pattern, and to this must be added edges for the seams and the wire. There must be some regard paid to the proportioning the various parts—the spout, the handles, sprinkler, etc. The sprinklers run from 4 inches in diameter down to 2 inches.

It is important to know how to notch the pieces properly, the top of the pattern for the take up of the wire, and the bottom notched so as to have only a single lap of metal when grooved and seamed together. Every experienced tinsmith understands the importance of this matter of properly notching patterns for seams and wiring. If a 3-16-inch wire is to be used, as shown in Fig. 34, then the pattern should be notched as shown in Fig. 35. The grooved seam should extend up to the center of wire, as shown at *m* in Fig. 34 and in the pattern at *p* in Fig. 35. The distance *p q* in Fig. 35 must be of sufficient width to cover wire, as shown in Fig. 34. In making allowance for the seam at each end of the pattern add one and one-half times width of edge or lock turned for the seam. If ⅛-inch edge is turned for the seam, then add 3-16 inch to each end of pattern, as shown by *n o* in Fig. 35. In notching the bottom of the pattern, where the ⅛-inch edge is used, cut away 3-16 inch on an angle of about 45 degrees. After the pattern is properly notched then punch out the hole in the pattern for the spout. After the pattern is edged, wired, formed, grooved together, and the bottom double seamed on, a suitable shaped top should be made, as shown by D in Fig. 28, and by the plan in Fig. 30, which is shown in the form of a crescent. Fig. 31 is the developed pattern of the crescent shaped water guard, as shown by D′ in the plan, Fig. 30, and as shown by D in the elevation, Fig. 28. Draw a horizontal line through the center of the plan in Fig. 30, extending it to 1, as shown in Fig. 31. With *h s* as a radius, as shown in the upper part of Fig. 32, and with *s′* as a center and with *s* 1 as a radius, equal to *h s* in Fig. 32, scribe an arc as shown in Fig. 31. Then space off on the outer circle of the plan of the crescent,

as shown in Fig. 30, the points 1, 2, 3, 4, 5, 6, then transfer the same space to the arc thus scribed in Fig. 31. This gives the distance 1, 2, 3, 4, 5, 6 on enlarged circle in Fig. 31, the same as from 1 to 6 in Fig. 30. Make 1 *f* in Fig. 31 equal to *h k* in Fig. 32, the width of the crescent in the center. Draw line



Details, Proportion and Patterns of Watering Pots

from 6 to *f* at the center *h'* on this line 6 *f*, and at right angles with it draw line to *g*, and with *g f* as a radius scribe the arc at *f*, intersecting the outer circle at 6 on both sides and completing the pattern.

In Fig. 32 a method is shown of proportioning the crescent top to the various sizes of watering pots, so that the general proportion will be the same. The lower part of Fig. 32 shows a plan of the various sizes of watering pots. The relative position of *c* in the outer circle in Fig. 32 is the same as 6 in Fig. 30, as shown by dotted line 6 *c*. From *c* in the outer circle draw line to center *e*, cutting the other circles at points 1, 2, 3, 4. Above this plan in Fig. 32 draw the line *h g* at right angles with the center *e i*, and of sufficient length to intersect with perpendicular lines from the outer diameter of the plan. From points *c* 1, 2, 3, 4 thus established in the plan draw perpendicular lines intersecting line *h k*, and from the center *e* draw the horizontal line cutting through the circles at points 1, 2, 3, 4, 5, and from these points draw perpendicular lines intersecting the line *h* J. These points thus established on this line *h g* give the relative proportion in length in elevation of the crescent top for the various sizes of watering pots. To proportion the hight of the various sizes of these tops they must all have the same pitch, as shown by dotted lines, as the outer solid line.

Fig. 33 shows a method of proportioning the top bail or handle of the watering pot. The idea is to have the half-circle of the handle come even with the top edge of the crescent top, and *h' g'* forms the base line equal in width to the largest diameter. The hight is represented by *k' l'*. The lines *h' k'* and *k' J'* are what may be termed the grading lines, to proportion the length of the straight sides of the bails or handles for the various sizes of the watering pots.

Fig. 39 shows a method of proportioning the width of the handles, which naturally should vary according to the size of handle required. If the bail or handle for a 12-quart watering pot is made 1½ inches wide, smaller sizes must be proportionally less in width. The smallest, as shown, would be about ¾ inch wide. Add edges for wiring. In Fig. 29 the size and dimensions are given of watering pots of the following sizes: 1 quart, 3 quarts, 6 quarts, 9 quarts and 12 quarts, giving their various hights and diameters. The circumference is secured by multiplying the diameter by 3 1-7, and is practically near enough for an article of this kind. The circumference of a 1-quart pot is 12½ inches, so that the net size of pattern required, outside of seam, would be 4 5-8 × 12½ inches. So in like manner with the other sizes. A 3-quart pattern, net size, would be 7⅙ × 17⅔ inches; a 6-quart, 9 × 22 inches; a 9-quart, 10 3-8 × 25⅛ inches, and a 12-quart pattern, without seam, would be 11¾ × 27½ inches.

In Fig. 36 the points 1, 2, 3, 4 show the developed pattern of the spout E. This is secured by extending the tapering sides of the spout E until they intersect at *w*. Extend the upper line of the spout E with dotted lines to *y* the same

in length as the lower line of the spout E. Scribe the half circle x, and space off this half circle into a given number of points. Space off these same number of points with their duplicates on curved line y z between the points 5 and 6. This gives the circumference at the largest end of the spout E. Draw lines from all these points to w. From w draw lines down through the spout E intersecting the points established in the half circle x. With w as a center and the radius at the various points where these lines thus drawn intersect with the line of the body of the watering pot A, scribe the various arcs, as shown by dotted lines, and intersect them with the corresponding lines in pattern drawn to the center w. By connecting these points it gives the miter pattern 1, 4.

Fig. 37 is the developed pattern of the tapering part of the sprinkler F. Fig. 38 is the developed pattern of the socket on the end of the sprinkler that slips down over the end of the spout E to hold the sprinkler in position.

PATTERNS FOR SPRINKLING CAN

In Fig. 40 is shown a perspective view of a sprinkling can, the construction and patterns for which are shown in Figs. 41 to 43, inclusive. In Fig. 41 A shows the spout joining the body G at a and b. At c a zinc sprinkler head is soldered. The bottom B is seamed to the body as shown at e and d. The body of the can has an ogee swedge at m and m and a wire edge at f and i. The can lip has a wire edge at h and an edge to solder at f. The cross brace at J supports the spout, and is soldered at t and u. The handle is soldered at o and n, and r is the grasp. The handle shown by B in Fig. 40 is omitted in Fig. 41.

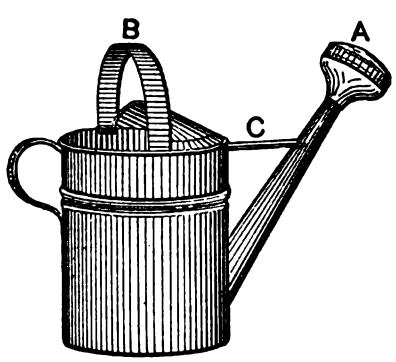


Fig. 40. General View of Can

The difficult patterns to be developed in this sprinkler are the spout, the opening in can to receive the spout and the lip. To avoid a confusion of lines these three patterns have been developed separately. The patterns for the spout and the opening in the can are shown in Fig. 42, though somewhat out of proportion to show clearly the principles involved. It should be understood that it makes no difference what the size of the can or spout may be, or at what angle it is placed, the rule holds good. Let A represent a part elevation of the can and B its plan.

Draw the outline of the spout as desired, as shown by C D E F and extend C D and F E until they meet in the apex at G. At will, extend the sides C D and

F E downward, making the distance G 5 and G 1 equal, and draw the diameter 1 5, upon which place the semiplan 1 3 5. Divide this into equal spaces as shown, from which points, perpendicular to 1 5, draw lines intersecting the diameter 1 5 at 2′, 3′ and 4′, and from these points draw radial lines to G.

Through the center *a* of the plan B draw the line *a* G¹, which intersect by a vertical line dropped from G in elevation. Then G¹, which gives the apex of the spout in plan. From the various intersections, 1, 2′, 3′, 4′ and 5, on the base of the cone in elevation, drop vertical lines cutting the center line in plan, as shown by similar numbers. Now take the various projections from the line 1 5 in elevation to points 2 3 and 4 in the semiplan, and place them on similar lines drawn into the plan, measuring from the center line *a* G¹, and obtain points 2 3 and 4.

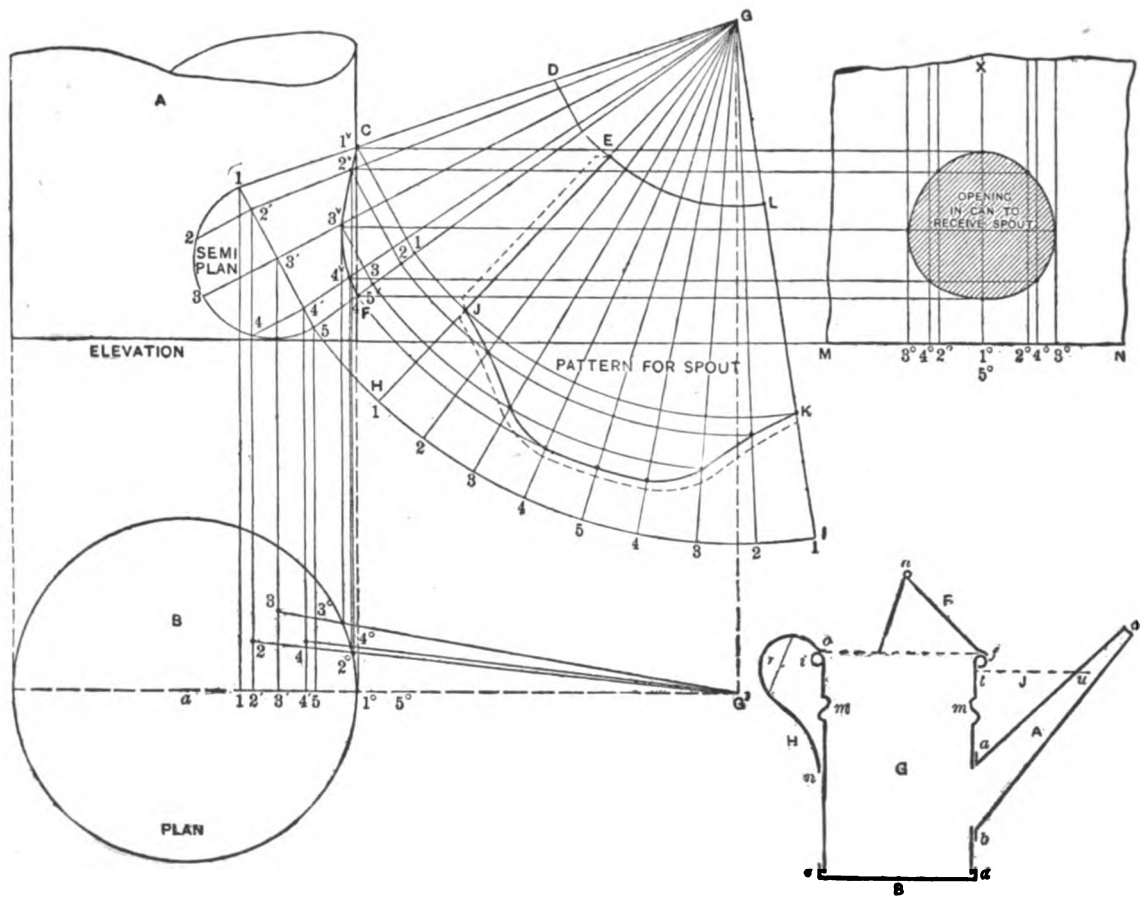


Fig. 42. Pattern for Spout

Fig. 41. Section of Can

From these points draw lines to the apex G¹, cutting the circle or plan of the can at 1°, 5°, 2°, 4°, 3°. From these points lines are erected into the elevation, cutting similar radial lines as indicated at 1ᵛ 2ᵛ, 3ᵛ, 4ᵛ and 5ᵛ. A line traced through these points gives the miter line between the spout and can.

From the various intersections 1ᵛ to 5ᵛ, at right angles to the center line G 3, draw lines cutting the side of the cone E F from 1 to 5ᵛ. With G as center and G 5 as radius draw the arc H I, upon which place twice the girth of the semiplan from 1 to 5 to 1, and draw radial lines to the apex G. Then with radii equal to G E, G 1, 2, 3, 4, 5ᵛ draw arcs intersecting similar radial lines as shown. Trace a line through points thus obtained, and J K L E will be the pattern for the spout. Dotted lines show laps.

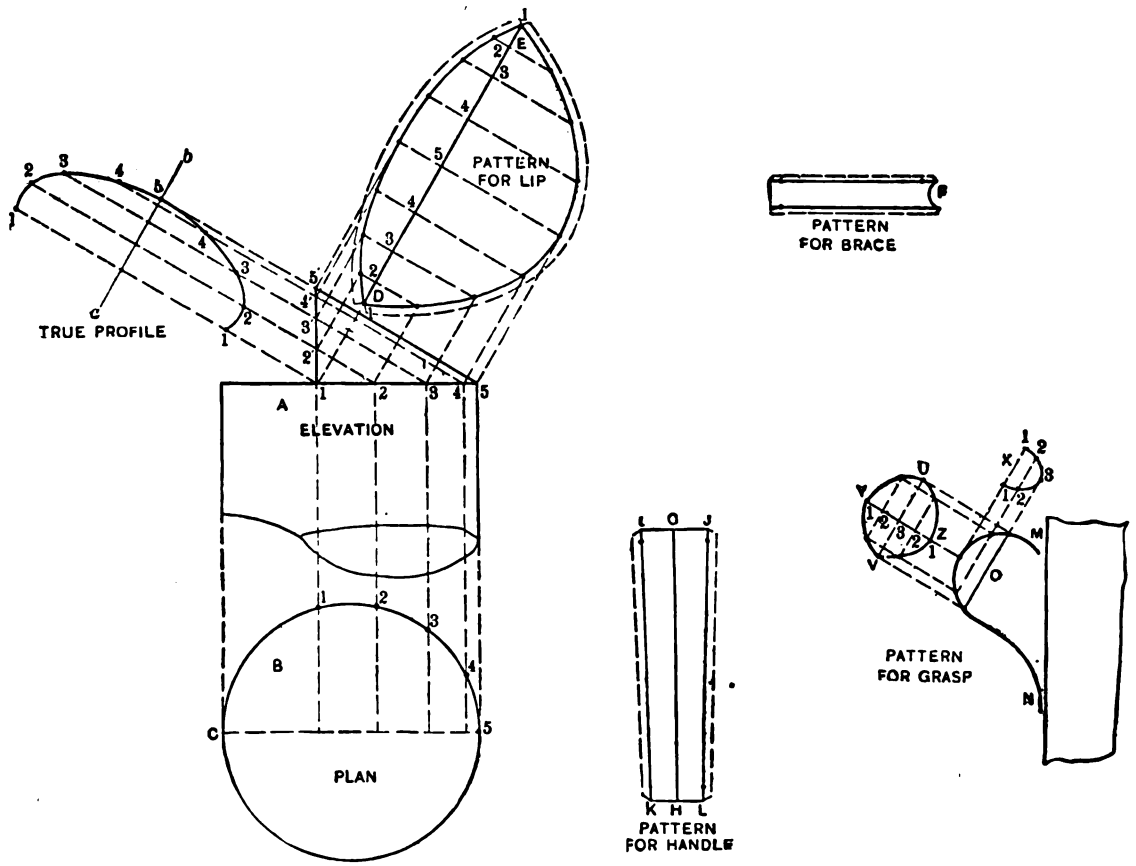


Fig. 43. Patterns for Can Lip, Handles and Brace

The opening to be cut into the can to receive the spout is obtained by taking the stretchout of 1°, 5°, 2°, 4°, 3° in plan, and placing this on the line M N on either side of the center line X. Vertical lines are now erected and intersected by horizontal lines drawn from similar numbers in the miter line C F in elevation. The shaded portion shows the shape of opening.

Four patterns are shown in Fig. 43, the one for the can lip being obtained as follows: Let A represent the elevation of the can and B the plan. Draw the center line C 5. Draw the angle of the lip desired, as shown by 5 5′ 1 in elevation, and extend 5′ 1, cutting the plan at 1. Divide the distance in plan from 1 to 5 as

shown, from which erect vertical lines cutting the can from 1 to 5 in elevation. From these points, parallel to the angle 5 5′, draw lines indefinitely, cutting the vertical line 5′ 1 at 4′ 3′ 2′. Draw the perpendicular line *a b*, then measuring from the line C 5 in plan, take the various projections to points 1, 2, 3 and 4, and place them on similar numbered lines in the true profile on either side of the line *a b*, resulting when a line is traced through points thus obtained in the true profile 1 5 1.

Take the girth of this true profile and place it on D E drawn at right angles to 5 5′, through which draw the usual measuring lines parallel to 5 5′ and intersect them by lines drawn perpendicular to 5′ 5 from similar numbered points on 5′ 1 and 1 5. The pattern for the lip is shown by the solid line, while the dotted lines show edges.

The pattern for the brace shown by C in Fig. 40 is shown by F in Fig. 43. Hem edges are allowed, the arc F being made to fit circle of spout. The side handle is shown at M N. The girth is taken and placed on G H; I J and K L are added with hem edges as shown; O in M N shows the side of the grasp, with its section shown at X. Divide X into equal parts as shown, and draw lines through these points parallel to O, cutting the outline of the handle as shown. The girth of X is now placed on Y Z, the usual measuring lines drawn and intersected by lines drawn at right angles to O from similar intersections on M N. The desired pattern is shown by Y U Z V. This same rule is applied if a grasp was desired on the top handle shown by B in Fig. 40.

INK FOR MARKING TINWARE, ATTACHING LABELS

A good ink for marking tinware is made by reducing asphalt or black varnish with turpentine to the desired consistency. It should be kept in a corked bottle, and, when wanted for use, the bottle should be shaken thoroughly. On withdrawing the cork enough of the marking fluid will adhere to it so that when the pen is applied to the cork it will fill with the fluid. This ink can be used for marking any bright article, as well as tinware, and it can be removed by means of a cloth dipped in coal oil or turpentine. Another ink is made by reducing shellac varnish with alcohol and adding a sufficient quantity of the finest lamp black. This forms a jet black lusterless ink, which is insoluble in water, but can be removed by a drop of alcohol.

There are occasions when it is desirable to attach labels to tin, and as ordinary paste or mucilage is not adapted to the purpose, the following methods are given:

1. If the paper is well sized and will resume its original color when the paste is dry, use a solution of balsam of fir, 1 part, in oil of turpentine, 2 or 3 parts.

2. Soften 1 part of good glue in water, then pour off the excess, and boil it with 8 parts of strong vinegar (about 8 per cent.). Thicken the liquid, while boiling, with enough of fine wheat flour or dextrin.

3. Make starch paste and add to it while warm a little Venice turpentine, so that the latter will become evenly distributed through it.

4. Add to starch paste, or any other similar aqueous paste (except that made from gum Arabic), some solution of shellac in borax. The quantity may be easily determined by trial.

5. Paint the spot where the label is to be put with a solution of tannin and let it dry. Affix the label, previously gummed and wetted.

6. Paint the spot over lightly with a camel's hair brush dipped into chloride of antimony.

7. Make a dilute solution of white gelatin, or, better, of isinglass, about 1 in 20. This is said to adhere without the addition of anything else.

8. To mucilage of acacia, starch, dextrin or tragacanth paste, add a little ammonia.

9. Or add a little tartaric acid. A trifle of glycerin may be added besides.

10. Mucilage of gum Arabic may be made much more adhesive by heating 100 parts of it with 2 parts of sulphate of aluminum, previously dissolved in hot water, to boiling, and then allowing to settle. A little tartaric acid and some glycerin added to the clear liquid after it is decanted will improve it.

11. Make a mixture of mucilage of tragacanth, 10 parts, and flour, 1 part.

PATTERN FOR COPPER STOVE RESERVOIR

For the most correct and quickest way to make a copper stove reservoir out of 14×48-inch sheet copper, with two seams in the body, the finished reservoir to be 12 inches deep, 17×10 inches at the top and 16×9 inches at the bottom, proceed as follows:

Assuming the body is to be in two pieces, with seams at two corners, it will require using stock size of 14-inch wide copper, a length of 28 inches for each half pattern, and the correct rule for laying out the pattern direct upon a sheet of copper without using any drawings but the measurements above given, is in Fig. 44. Let A B C D represent a sheet 14×28 inches in size; draw the line E F parallel to A

B, making the distance A E equal to the width of the top flange, and place E from the edge A D as much as required for edges for seaming. Make E F equal to 17 inches and bisect the line as at G. From G, at right angles to E F draw G H, equal to 12 inches, and from H, parallel to E F, draw I J, making H I and H J each equal to 8 inches, making I J 16 inches; draw lines from E to I and F to J. Then will E F J I be the pattern for the long side. As the flare is equal all around, with F as center and any radius, describe the arc K L, intersecting the line F J at M. With M as center and M K as radius intersect the arc K L at

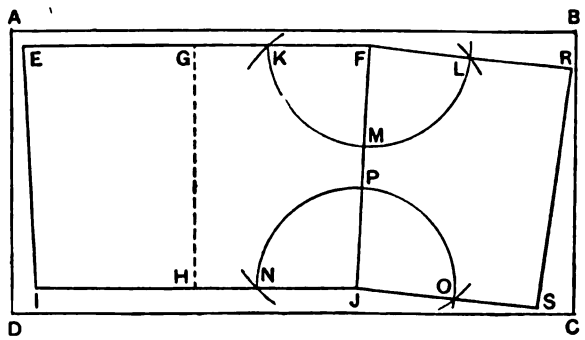


Fig. 44. Body Pattern of Copper Stove Reservoir

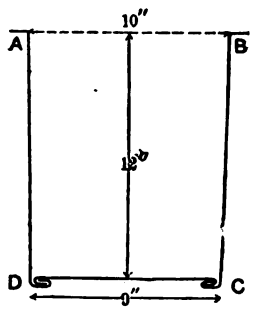


Fig. 45. End Section

L. Draw a line from F through the intersection L, as F R, which make equal to 10 inches. In similar manner the angle P O can be made equal to P N; or, from J draw the line J S parallel to F R, making J S equal to 9 inches, and draw line from R to S. Then will E F R S J I represent a one-half pattern for the reservoir, flanges to be allowed for seaming. It will be noticed that the distance from G to H was made 12 inches, or the depth of the article, because in this case the flare, as shown from B to C in Fig. 45, is but 1-32 inch more in length than the straight hight. If, however, the flare was greater, the distance from B to C would be the length from G to H in Fig. 44. In Fig. 45 is shown the section through the article with flanges at A and B and double seams at the bottom at C and D. If desired, the corners can be slightly rounded. It is suggested that 28-inch wide copper be employed; as that is stock size, no waste will result.

PATTERN FOR ICE CREAM MOLD

An article which can be made from IX tin or No. 24 galvanized iron, is an ice cream mold (brick form). In Fig. 46 is shown a perspective view of the mold with cover. The corners can either be riveted, as shown by C and D, or double seamed. The seams should be soldered on the inside in such a manner that the

inside surface will be as perfectly smooth as if the mold were stamped in one piece. While some molds are made perfectly square—that is, no bevel is given to the sides—this pattern is cut on a bevel to allow the cream to slip out easily.

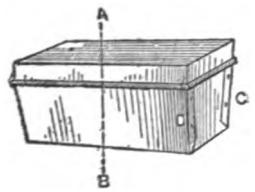


Fig. 46. Perspective View of Finished Ice Cream Mold

In laying out the pattern it is not necessary to draw the entire form, but only one corner. Providing that all the sides have the same bevel, this one corner pattern is all that will be required to obtain the pattern in one piece. In Fig. 47 let 1, 2, 3, 4 be a section taken through A B in Fig. 46; 1, 2, 3 in Fig. 47 being the body of the mold, with wire at 3, while 4 indicates the cover. For the pattern for the corner draw any line, as C D, at right angles to *a* 1, upon which place the stretchout of 1, 2 and 3 in the section, as shown by 1, 2 and 3 on C

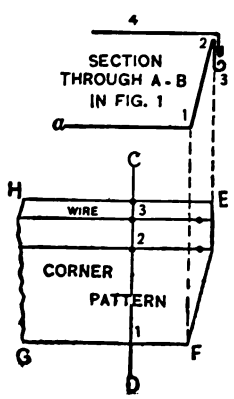


Fig. 47. Method of Obtaining Pattern for One Corner

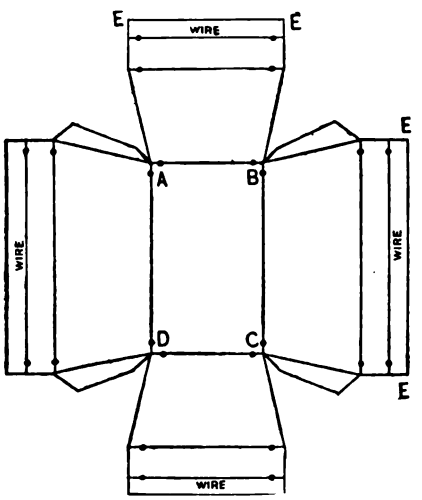


Fig. 48. Pattern for Mold in One Piece

D, also allowing for wire, as shown. At right angles to C D and through the small figures draw lines, as shown, which intersect with lines drawn at right angles to *a* 1 from intersections 1, 2 and 3 in the section. Trace a line through points thus obtained. Then will E F G H be the corner pattern.

Assuming that the bottom of the mold is to be of a given size, as shown by A B C D in Fig. 48, around which the sides are to be constructed, take the pattern G F E in Fig. 47, and, laying the line G F successively against the corners and lines A B, B C, C D and D A in Fig. 48, turning the pattern right and left as required, mark off the miters E, E, E, etc., as shown. Then will the pattern shown in Fig. 48 be the full pattern for the mold in one piece. Allowance must be made for seaming or riveting, as shown. The pattern for the cover 4 in Fig. 47 is so simple that a description is omitted.

PATTERN FOR TUMBLER DRAINER

The finished view of a tumbler drainer is shown in Fig. 49. This article can be made from zinc, galvanized iron, bright tin, copper and brass. When made from polished sheet brass or copper it has an attractive appearance on a counter. Those made of the first three materials are usually japanned in colors. It will be noticed a heavy beaded edge is placed at *a a*, while at *b b b* buttons are soldered to prevent the bottom of the pan from scratching the counter. If desired, ornamental brass legs can be used on the copper and brass drainers.

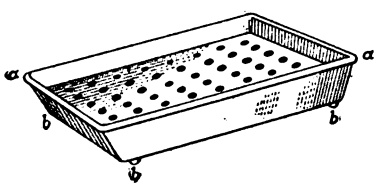


Fig. 49. Perspective View of Tumbler Drainer

Fig. 50 shows the cross section through the pan, with a wired edge at *a a*, and *b*, *b'* and *b* represent small angles bent to the shape shown and soldered to the ends and sides. On the top of these the drainer *c* rests. In the drainer *c* small perforations are made with a 3/8-inch hollow punch. After punching these holes on a block of lead the burr should not be flattened, but should remain as shown in *c*, which forms a drip. Around the drainer *c* bend down 1/4 inch all around to stiffen the edges. The concave buttons *f* and *f* are punchings obtained from a 1-inch hollow punch. These punchings are concave, and in that shape should be soldered to the bottom of the pan.

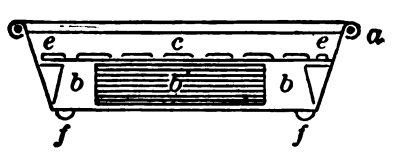


Fig. 50. Sectional View

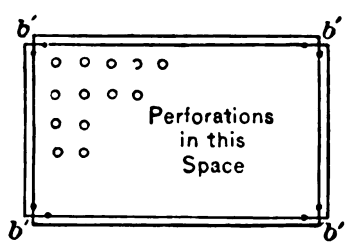


Fig. 52. Pattern for Drainer

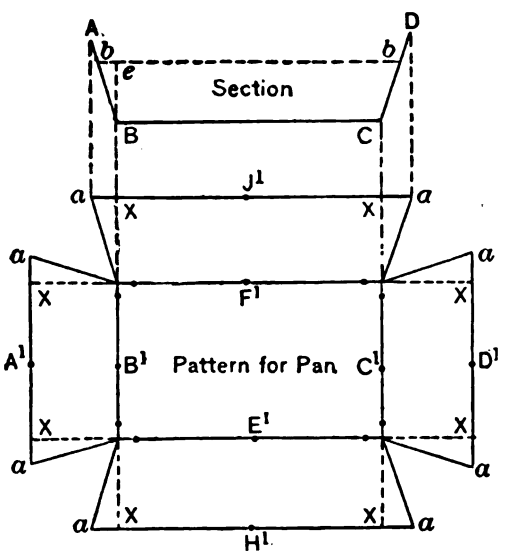


Fig. 51. Pattern for Pan

Fig. 51 shows how the patterns for the drainer and pan are developed. A B C D is a reproduction of *a f f a* in Fig. 50, minus the wire or beaded edge. Draw the desired bottom of the pan below the section, as shown by B^1 C^1 E^1 F^1. Take

the distance of A B or C D in the section and place it at right angles to the sides of the bottom, as shown by A^1, J^1, D^1, H^1. Through these points draw the lines *a a* on each side, parallel to the sides. At right angles to B C in section, and from the points A and D, drop lines intersecting the line J^1 and H^1 at *a a a a*. Take the distance from X to *a* and place this projection at the ends on the lines A^1 and D^1, as shown. Connect lines, as shown, which will be the desired pattern, to which allowance must be made for seaming and wiring.

The pattern for the drainer, represented by *b b* in section, is cut, as shown in Fig. 52, as much larger than the bottom of the pan as the projection *e b* in section indicates. In other words, if the bottom of the pan measures 10×14 inches, and the projection *e b* equals ½ inch, then will the pattern for drainer *b' b' b' b'* measure 11×15 inches, to which edges are allowed. Perforations are made in the space shown.

PATTERN FOR PAN WITH WATER TIGHT CORNERS

A perspective view of a pan in which the corners are made water tight is shown in Fig. 53. This is accomplished by means of folding the corners together and turning them to the sides, or ends, as shown by *a* and *b*. Perhaps it would be more readily understood to say that this procedure is commonly called, "Making drip pans."

The usual practice in the shop is to lay off the pattern directly on the metal, using the steel square and dividers. These pans can be made from tin, black or plainshed iron, galvanized iron, copper or brass. When made from tin or black iron they are used for baking; from planished iron for roasting, from galvanized iron for drip or water pans, and from polished copper or brass for confectioners' displays.

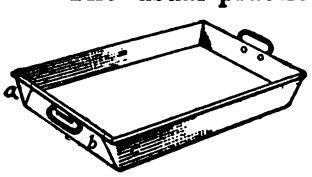


Fig. 53. Perspective View

In Fig. 54 is shown the method employed in obtaining the pattern for a pan the flare of which is equal on all sides. Draw A B C D, the elevation of the pan. Directly below it draw E F G H, the bottom. Take the distance C to B and place it at right angles to the ends and sides of the bottom, as shown by B^1 B^2 B^3 and B^4, through which draw lines parallel to the ends and sides, as shown. Extend E F, H G, F G and E H, intersecting the lines just drawn at *b b'*, *c c'*, *d d'* and *e e'*. Take the projection of the flare *a* B in elevation and set it off on the four sides of the pan, as shown by *b a'*, *c a'*, *d a'*, *c a'*, *c' a'*, *b' a'*, *e' a'* and *d' a'*. From the points *a'* draw lines to the corners E, F, G and H, which

would complete the pattern for the pan if the corners were soldered together raw edge.

To find out the amount of material necessary for folding the corners proceed as follows: If the flare is equal on all sides bisect the angle E F G. To do this use F as center, and with any radius draw the arc *f h*, intersecting E F and F G at *f* and *h*. Then, using *f* and *h* as centers, and with radius greater than half *f h*, draw arcs intersecting each other at *i*. Draw a line through *i* and F, as shown by *i j*. Then, using *a'* as center, with radius less than would meet *i j*, describe the arc *b m*, intersecting *a'* F at *n o*. Then, with *n* as center and *n b* as radius, describe an arc intersecting the arc *b m* at *o*. Draw a line from *a'* through *o*, intersecting the line *i j* at *l*. Draw a line from *l* to *a'*. Then will *a'* F *a' l a'* be the desired corner, which should be traced on each corner.

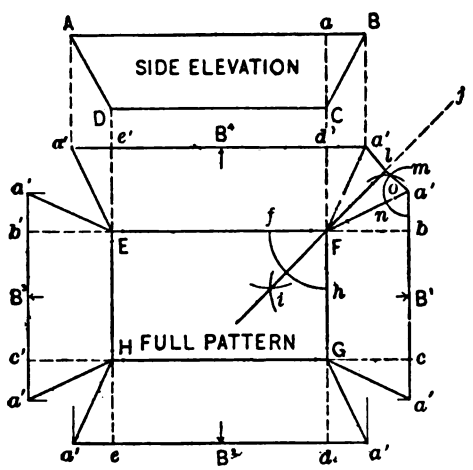


Fig. 54. Pattern for Pan with Equal Flares on All Sides

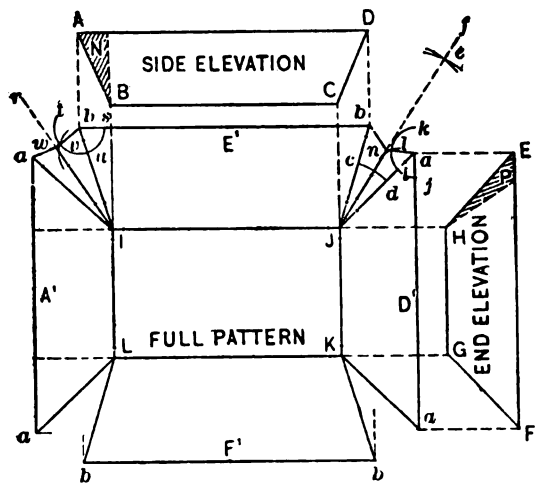


Fig. 55. Pattern for Pan with Different Flares on Sides from Ends

If a pan is desired, the ends of which have a different flare from those of the sides, as is shown in Fig. 55, in which A B C D shows the side elevation and E F G H the end elevation. In its proper position, draw the bottom of the pan I J K L. Take the distances C to D and B to A in side elevation, and G to F and H to E in end elevation, and place these distances at right angles to the ends and sides of the pan, as shown respectively by A^1, D^1, F^1 and E^1, through which points draw lines parallel to the ends and sides, as shown. Intersect these lines by lines drawn from A to D in side elevation, and E and F in end elevation, thus obtaining the intersections *b*, *b*, *b*, *b*, and *a*, *a*, *a*, *a*. Draw lines from the points *a* and *b* to the corners I, J, K and L, as shown, which would complete the pattern for the pan if the corners were soldered together raw edge.

In making these pans of unequal flare the folded corners are sometimes turned toward the ends of the pan, while they are sometimes folded toward the sides of the pan. Assuming that the corner is to be turned toward the end of the pan, as shown at P in end view, bisect the angle *b* J *a* in pattern, obtaining the line of bisection J *f*. With *a* of the *end miter* as center, and with radius less than would touch J *f*, describe the arc *j k*, intersecting *a* J at *i*. With *i* as center and *i j* as radius intersect *j k* at *l*. Draw a line from *a* through *l*, intersecting the line *f* J at *n*. From *n* draw a line to *b*. Then will *b* J *a l* be the pattern for the folded corner when it is turned toward the ends.

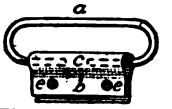


Fig. 56. Hinged Wire Handle

When the corner is to be turned toward the sides of the pan, as shown by N in side elevation, bisect the angle *b* I *a* by the line I *r*, and using *b* of the *side miter* as center, describe the arc *s t*. Then, using *u* as center and *u s* as radius, intersect the arcs *s*, *t*, at *v*. Draw a line from *b* through *v*, intersecting *r* I at *w*, and draw a line from *w* to *a*. Then will *a* I *b w* be the pattern for the folded corner when it is turned toward the sides. Note the difference between the shape of the two corners.

When making roasting, baking and drip pans the wire hinged handle is usually employed, as shown in Fig. 56, which shows the wire handle *a* fitting into the loop of the metal *b* at *c*. Holes are punched at *e* and *e* for riveting to the ends of the pan, as shown at *b* in Fig. 53.

In the confection pans made of brass or copper, stationary handles, as shown at H in Fig. 57, are used. The method of obtaining the pattern is shown in the same figure. Let A B C represent a portion of the pan, and E the side view of the handle. Draw the shape the handle is to have on the line 1′ 3′, as shown by D, which divide into equal spaces, as shown by the small figures 1 to 3 on either side, from which draw vertical lines intersecting the bottom of the handle E at 1′ 2′ and 3′, from which points, parallel to 1′ 1″, draw lines indefinitely, as shown by 1°, 2°, 3°, intersecting the side of the pan A B at 1″, 2″, 3′. A true section must now be obtained on the line E 3′, as follows: Draw 1^x D^1 at right angles to 1′ 1°. Measuring from 1 D, take the distances to points 2 and 3 and place them on similar numbered lines, measuring from the line 1^x D^1, thus obtaining the points 1^x, 2^x, 3^x on both sides, through which trace a curved line, which will be the true section on E 3′ in side. For the pattern extend the line 3′ E, as E E^1,

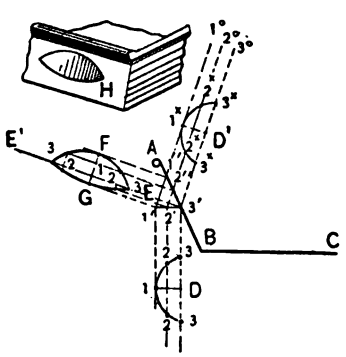


Fig. 57. Pattern for Soldered Handle

upon which place the stretchout of the profile D^1, as shown by similar figures on E E^1. At right angles to E E^1 and through the small figures draw lines, which intersect with lines drawn from similar numbered intersections on A B and 3′ 1′ at right angles to 1′ 1″. Trace a curved line through the points thus obtained. Then will 3 F 3 G be the pattern for the handle. These handles are generally soldered to the pan on the inside of the handle H. Any solder showing is scraped off.

CAKE CUTTERS

Bright pieces of scrap tin can be utilized to make lady finger, patty, biscuit, doughnut, cookey, cake, animal, tart and muffin cutters. These are easily made, prove attractive, and sell readily if an assortment of forms is kept on hand. In Fig. 58 is shown a variety of simple forms. To make the full sized drawings of these figures the method shown in Fig. 59 may be used. Divide the length of the smaller outline into an equal number of spaces, as shown by the small figures 1 to 8, and the hight into any number of equal parts, as shown from *a* to *g*. Through the small figures 1 to 8 and letter *a* to *g* draw lines at right angles to each other, intersecting each other, as shown, and crossing the outline of the figure.

Assuming that the outline of the horse is to be made twice the size of the small diagram, set off a distance equal to twice the amount of 1 to 8, as shown by 1′ to 8′, and twice the hight *a g*, as shown by *a′ g′*. As 1 to 8 is divided into eight parts, and *a g* into seven, then divide 1′ to 8′ into eight parts and *a′ g′* into seven, respectively. Through points 1′ to 8′ and *a′* to *g′* draw lines at right angles to each other, as shown. Following the smaller diagram as a guide, the large one is traced through corresponding squares. In this manner any figure

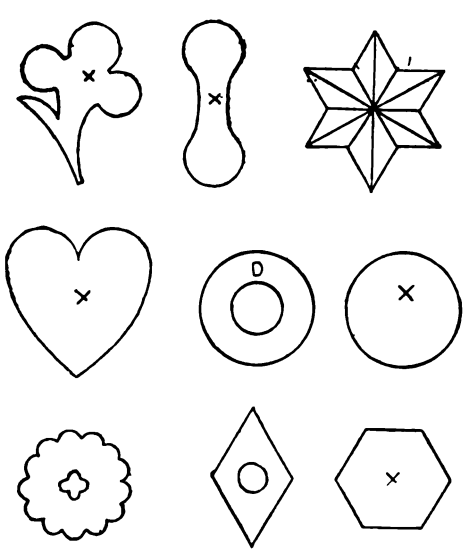


Fig. 58. Simple Forms of Cake Cutters

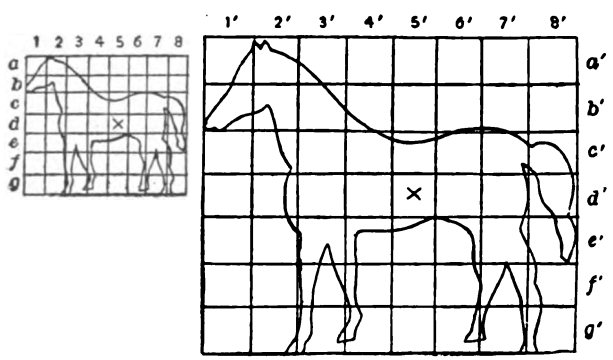


Fig. 59. Method of Enlarging Figures

can be enlarged to any size. If the outline was required six times as large as the small diagram, then would the length 1 to 8 and hight *a g* be made six times as large; divide the spaces thus obtained into the same number of divisions as in the original diagram. In Fig. 60 is shown an outline of a bird and barking dog. These or any other figures can be enlarged, using the above method. A mechanical instrument known as a pantograph can be bought from a dealer in drawing instruments. The cost of these is not large and usually full instructions are furnished.

The cutters are constructed as shown in Fig. 61, in which A represents a flat piece of tin of the required size, onto which strips of tin ⅜ inch wide, which have been formed to the outline of the figure desired, are tacked with solder at *a* and *a*.

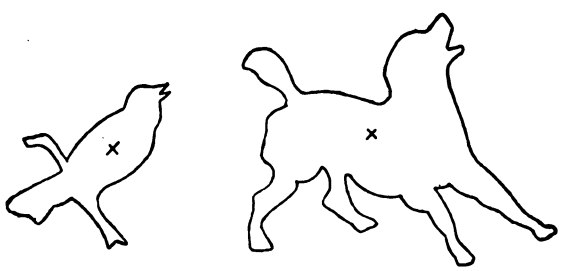


Fig. 60. Bird and Dog

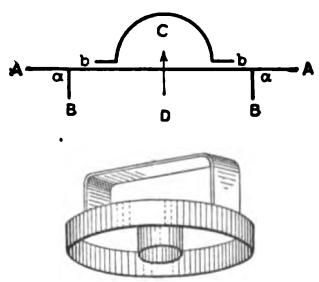


Fig. 61. Construction of the Cutter

Then a handle, shown at C, about ½ inch wide, with a hem edge bent toward the inside, is soldered to the flat disk A at *b* and *b*. A ½-inch hole should be punched through the center of the disk, shown by the arrow point, also as is shown in all the diagrams by X in Figs. 58, 59 and 60, which allows the surplus dough to pass out at the top when cutting the various figures. D in Fig. 61 shows a perspective view of a doughnut cutter, showing how the handle and strips are put together, being the finished article of D in Fig. 58.

DETAILS OF A PEANUT HEATER

One of the simplest forms of a peanut heater, fulfilling the requirements of ordinary conditions, is shown in the accompanying illustrations, Fig. 62, showing a side and Fig. 63, an end view. First make the rectangular box A B D C, Fig. 62; from A to B, 18 inches; from C to D, 16 inches, and the straight depths

inches. From A to B, Fig. 63, is 10 inches, and C to D, 8 inches. Double seam the corners and bottom and solder well. Rivet in position 3 inches from the bottom a partition to form a water chamber, as shown, leaving holes for the tube

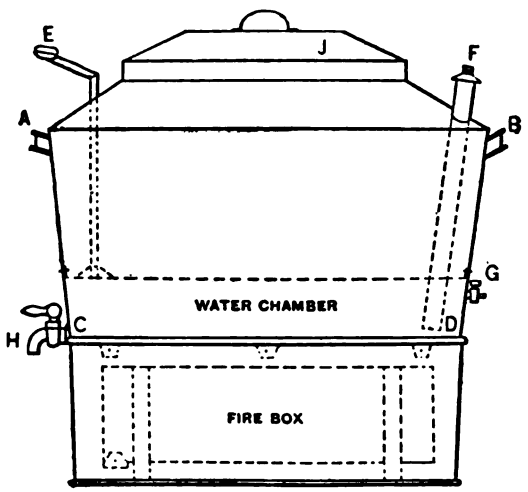


Fig. 62. Side View of Peanut Heater

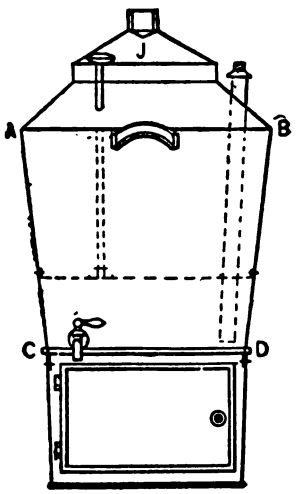


Fig. 63. End View

E for steam whistle, 3-8 inch in diameter, and F for a water filler, 1 inch in diameter, having a screw cap at the top with a small hole in it, which will indicate when water is low by emitting steam. Put in a small pet cock at G, which will be high water mark, and a faucet at H to empty reservoir. Make the breast with a rim 1 inch high, into which will fit the cover J, which should fit easily and may be hinged if desired. Now make the rectangular box to hold the fire pan, wire it around the top, and swing a door at each end. Rivet three braces of 1-inch band iron across, as shown, upon which will rest the upper section. Punch ½-inch holes along the top of each side, to let out the gas from the burning charcoal. The fire pan, which is shown in Fig. 64, is made semi-cylindrical in form, 5 inches wide and 14 inches in length, perforated with 3-8-inch holes, to permit the combustion of the charcoal, which may be regulated by a draft slide placed in one of the doors. This pan must be supported by legs made from 1-inch band iron, so that the air has free circulation all around it; also rivet a small lug at each end, to admit a handle made after the manner of a stove lifter, by which the fire pan may be removed without burning the hands. The whistle is made from two disks 1½ inches in diameter, raised and soldered together, and having a small hole in the under side, upon the edge of which the steam is blown.

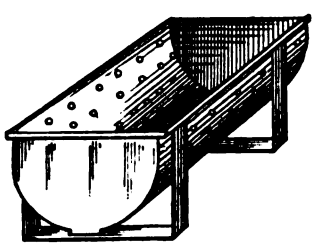


Fig. 64. Fire Pan

CANDLE MOLDS

That the tinsmith, or sheet metal worker as he is now called, may receive an order for an article that is practically obsolete is evidenced by the receipt of a description from a tinsmith of candle molds, made by him pursuant to an order. Hence, the presenting here of this description may be of use to others.

Fortunately this tinsmith had the opportunity to borrow an old mold made in the days of candles and was thereby saved the need of experimenting. The new candle mold is shown with the wicks in place and the drawing bar ready to pull the candles out of the mold after the tallow has hardened. Resting across the new one is the old candle mold that is now covered with rust and not fit for service, though it furnished the dimensions from which the new mold was made, as portrayed in the illustration, Fig. 65. The top, which serves as a funnel, accommodates molds for three candles and is 1⅝ in. wide, 3½ in. long and 1 in. deep. The molds are tapering, ⅞ in. in diameter at the top and ¾ in. in diameter at the bottom and 9¾ in. long. They are finished at the bottom with a short cone open at the apex, so that the wicks can be passed through and knotted.

The cylinders for the molds were formed on the candle mold stake that is in every tinshop but seldom used for its original purpose. The cones were formed on the beakhorn stake and all the parts were soldered together. Where a large number of candles were made in former times, 6 and 12 molds were assembled instead

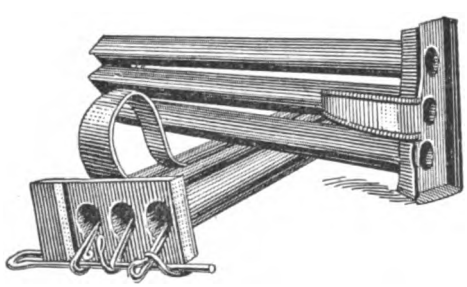


Fig. 65. The Old and New Candle Molds

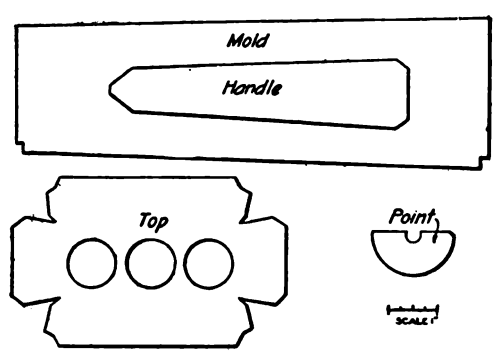


Fig. 66. Patterns for Candle Molds

of 3 as in the picture, and then instead of being soldered together at the bottom they were passed through holes in a tin brace similar to that at the top. This held them farther apart and quickened the cooling. Usually the mold is immersed in water when the candles are poured, so that if the tallow is hot it cannot possibly melt the solder. A suitable handle is an essential part and is soldered to the mold, as seen in the picture. The patterns for all the different parts are shown about one-quarter of the full size in Fig. 66.

PATTERN FOR SCALE SCOOP WITH FUNNEL END

A scale scoop with a funnel on one end is shown by Fig. 67, which gives the side view, section and radii of such a scoop. To make the pattern for this a correct side view of the scoop should be made, as follows: Draw any horizontal line, as L M. At right angles to L M draw the line B D, and make the distance 4 to D the same as 4 to B, then locate the points A and C, and draw lines A to B, B to C, C to D and D to A. Place the tube G H I J, as shown, and at pleasure draw the curve F K E. Then will J D E K F G be the side view of the scoop. With a radius equal to 4 B or 4 D and N on the line L M as center, describe the circle R P O M, which will represent a section through the line B D in side view. Divide the half circle O P R into equal spaces, as shown by the small figures 1 to 7, and from which, parallel to L M, draw lines intersecting the line B D from 1 to 7, as shown. From points 1 to 5 on D B draw lines to the apex C, while from points 5 to 7 draw lines to the apex A. Where the radial lines 2, 3 and 4 intersect the curve K E, draw at right angles to L M, lines intersecting the bottom of the scoop D C at 1′, 2′, 3′ and 4′. In similar manner, where the radial lines 5, 6 and 7 intersect the curve K F draw lines at right angles to L M, intersecting the scoop line J D at points D, 6′ and 7′.

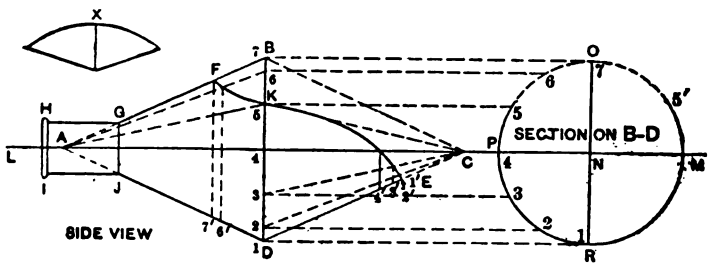


Fig. 67. Side View, Section and Radii

For the pattern for the one-half of the scoop K E D, the part without the funnel, take C D as radius and C in Fig. 68 as center and describe the arc 5 5. Draw the radial line C 1. The scoop on the line K D in Fig. 67 has only a part of the circle for its profile, as shown from 5 to 5′ in section, Fig. 67. Take the stretch-out from 1 to 5 in the section, and place it on either side of the point 1 in Fig. 68, as shown from 1 to 5. From these small figures draw radial lines to the center C, as shown. With radii equal to C 4′, C 3′, C 2′ and C 1′ in Fig. 67, and with C in Fig. 68 as center, intersect radial lines having similar numbers, as shown by 4′ 4′, 3′ 3′, 2′ 2′ and 1′, respectively, as shown. Trace a curved line through intersections thus obtained, as shown, from 5 to 1′ to 5, which completes the pattern. If a scale scoop were desired of a shape similar to X in Fig. 67, a duplicate of the pattern shown in Fig. 68 would be required and joined on the line K D in Fig. 67. The usual method of joining is to turn edges on each part as one would do in seaming elbows; but instead of leaving the seaming standing, it is doubled over.

For the opposite half of the scoop G F K D J, take A D as radius and with A in Fig. 69 as center describe the arc 7 7. Draw any radial line, as A 1, and set off on either side of point 1 the stretchout of the semicircle R P O in Fig. 67, as shown by the small figures 7 to 1 to 7 in Fig. 69. From points 5, 6 and 7 draw radial lines to the center A. Now with radii equal to A 7′ and A 6′ in Fig. 67 and A in Fig. 69 as center, intersect radial lines having similar numbers, as shown by 7′ 7′ and 6′ 6′. Trace a line through points thus obtained, as shown from 7′ to 5 and 5 to 7′. With radius equal to A J in Fig. 67 and with A in Fig. 69 as center, describe the arc J J. Then will J 7′ 5 1 5 7′ J be the desired pattern. Allow edges to all patterns for wiring and seaming. The tube shown by H G J I in Fig. 67 should have a wired edge at H I, as shown.

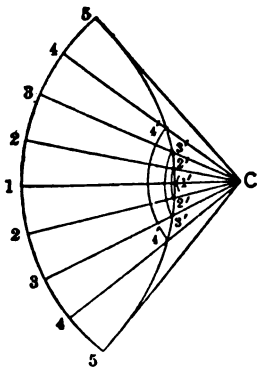


Fig. 68. Pattern for Half Scoop K E D in Fig. 67

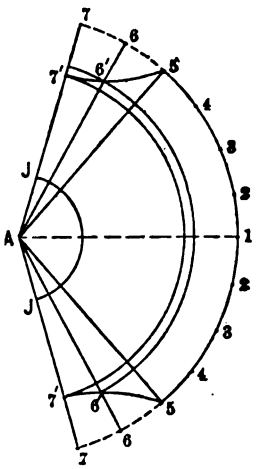


Fig. 69. Pattern for Half Scoop D K F G J in Fig. 67

PATTERNS FOR COLANDER

A perspective view of a colander, which is usually made from bright IC or IX charcoal tin, is shown in Fig. 70. The handles shown at A and A are tinned malleable iron handles, and are riveted to the body of the colander. They can, if desired, be made from tin plate and soldered on. A wired edge is placed at the top and at the bottom, as shown at *a* and *b*, respectively.

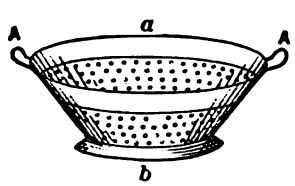


Fig. 70. Perspective View of Colander

The patterns for the colander are obtained as shown in Fig. 71, in which first draw the center line A B, upon which place the hight of the colander, as shown by A K. Draw the desired dimensions on either side of the center line, as shown by C D, E F, and G H. Extend the lines D E and C F, intersecting the center line A B at I. With K as center draw the semicircle 0 3 6, which divide into equal spaces, as shown by the small figures 0, 1, 2, 3, 4, 5, 6. Using I as center, with radii equal to I E and I D, draw the arcs N O and L M, respectively.

From any point, as L, draw the radial line L I, intersecting the arc N O at N. On the arc N O, starting from the point N, set off the stretchout of the semicircle 6 3 0,as shown by similar figures on N O. From the center I draw a line through O intersecting the arc L M at M. Then will L M O N be the half pattern for the body of the colander, to which laps must be allowed for seaming and wiring.

For the pattern for the base or foot of the colander extend the lines H E or G F in elevation until they intersect the center line at J. With radii equal to J F and J G and with B on the center line A B as center, describe the arcs E^1 F^1 and H^1 G^1, respectively. From G^1 draw the radial line to B intersecting the inner arc at F^1. From the point F^1 lay off on the arc F^1 E^1 the stretchout of the semicircle 6 3 0, as shown by similar figures on F^1 E^1. From the center B draw a line through E^1, exending it until it intersects the arc H^1 G^1 at H^1. Then will H^1 G^1 F^1 E^1 be the pattern for the foot of the colander. Laps must be allowed for edging and wiring. P in the front elevation indicates a small swedge, or bead, turned into the colander, below which perforations are made, which are also shown in the pattern. The bottom of the colander, which should also be perforated, is shown by the circle K. This bottom is oftentimes raised, so as to present a surface sufficiently stiff for all purposes, and the removal of buckles.

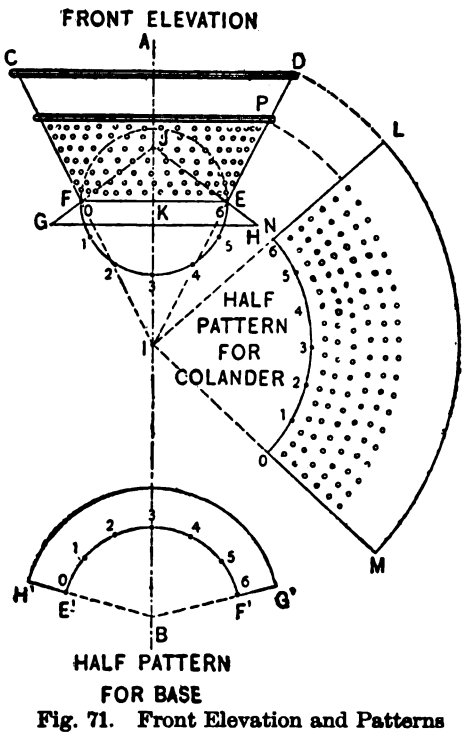


Fig. 71. Front Elevation and Patterns

TIN BASINS

The sizes and dimensions of basins presented on page 1 have long been the standard. This schedule in former years had a special value, because of the fact that such articles of tinware, as well as nearly all others, were made in larger quantities, such as gross lots, and the sizes of patterns were so proportioned as to cut stock to the best advantage with the least possible waste. In the illustrations herewith, it

has been aimed to show how this is accomplished with the least possible expense under the old regime of hand made tinware, as well as giving the required size of the various patterns.

Fig. 72 represents 1-pint, 3-pint and 2-quart tin basins, respectively. The pattern for the pint basin is made in two pieces, as shown by A in Fig. 72. In this pattern all edges must be allowed—3-16 inch on each end for lock seams, ⅛-inch edge on bottom, and ¼ inch at top for wire. Having allowed these edges, all the full size patterns required are in possession. It is found that you can get four pieces out of a 10×14-inch sheet, as shown in Fig. 73. These basins are

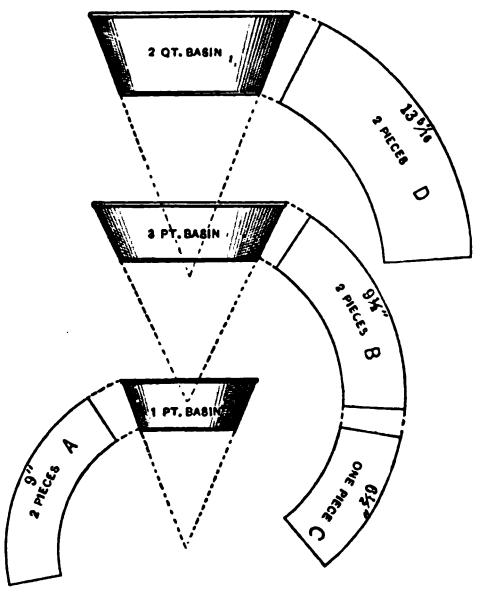


Fig. 72. 1-Pint, 3-Pint and 2-Quart Basins

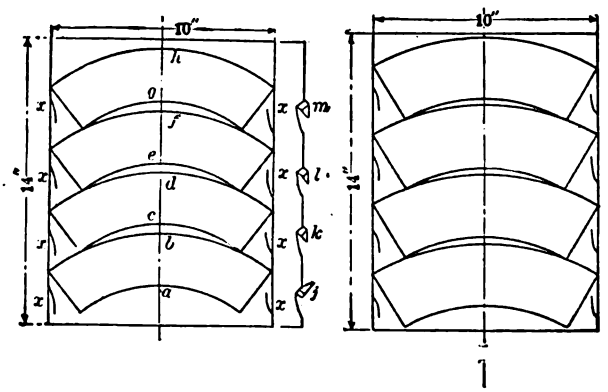


Fig. 73. Marking the Patterns on the Tin

made out of either IC or IXX tin, according to the quality of goods desired. When made of IC, the lightest tin, three sheets are cut out at a time, being locked together, as shown by *j*, *k*, *l* and *m*, in Fig. 73. The three sheets are first notched, as shown by *x*, *x*, *x*, *x*, on both sides of the sheet in Fig. 73. After thus notching the sheets first turn the lug up, then down on the back as at K. This completes the process, with the exception of flattening down the locks with a mallet, being sure that the point does not stand up, which naturally would tear the hands of the operator. This method holds the sheets firmly together.

When three sheets are cut out together only the top sheet is to be marked. When IXX tin is used for these basins it would be impracticable, if not impossible, to cut more than two sheets at a time. But the process of holding the sheets together by means of locked edges is the same as when IC tin is used. In either case, whether IC or IXX tin is used, the stock or bench shears should be used for cutting out. These are held firmly in position on the bench by means of a

hole or socket cut into the bench, near its outer edge, to receive the back end of the shears, and at the proper angle, so that the front or blade part of the shears will be the proper hight for working.

In cutting out the work cut the circle part first, as this enables the three pieces to be held together by the lugs at each end until the straight sides of the pattern are cut away and properly notched, as shown in Fig. 75. In commencing to cut out the work begin at the bottom of the sheet and cut away the circle *a*, as shown

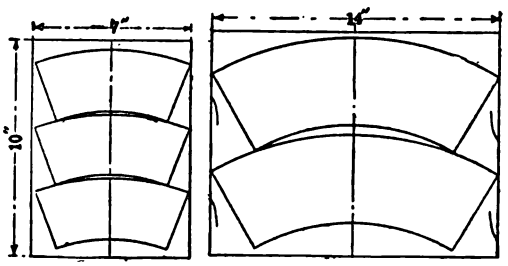


Fig. 74. Marking the Patterns on the Tin

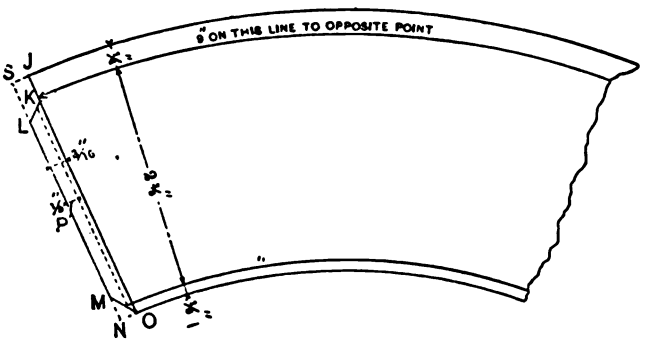


Fig. 75. Allowing Laps and Notching

in Fig. 73; then the circle *b*, and then all the other circles shown on the sheet up to *h* and inclusive. Leave the three pieces in each of the four sections intact until the ends with lugs are cut off and properly notched, as shown in Fig. 75. Referring to Fig. 75, the notching of the end of the patterns is sufficient in width for the take-up of the seams, 3-16 inch, as shown by S J. Make J K 5-16 inch. Then cut away S J K L and the correct notching is obtained of the top of the pattern for the wire. At the bottom cut away the point M N O on a slant of 45 degrees, making the distance N O the same as S J, or 3-16 inch in width. The size or width of lock is two-thirds the width of the cut-away S J and N O—3-16 inch—and hence must be ⅛ inch, as shown by the dotted line at P.

The same process is carried out in cutting out the patterns for the 3-pint and 2-quart basins as for the 1-pint basin. Referring to the 3-pint basin in Fig. 72, it is found that the best size for the patterns to cut stock most economically is as shown, with two pieces of the B size pattern and one of the C size. Four pieces of the B pattern cut out of a 10×14-inch sheet of tin, as shown in Fig. 73. Three pieces of the C pattern cut out of a 7×10-inch sheet of tin, as shown in Fig. 74, or six pieces out of a 10×14-inch size. Sometimes when cutting out this latter pattern, instead of notching for lugs at each side of the sheet, as in the other patterns, the 10×14-inch sheet of tin is doubled together in the center of the 14-inch side of the sheet, thus making the side notching of the sheets unnecessary, as

the folded edge on the one side holds the parts together until the work is cut out, leaving the folded end of the sheet as the last to be cut.

As will be observed in referring to Fig. 72, which shows the profile of a 2-quart basin, it requires two pieces of pattern D. These cut out of a 10×14-inch sheet of tin, but two pieces out of the long or 14-inch way of the sheet, as shown in Fig. 74.

The bottom for a 1-pint basin is cut $4\frac{3}{4}$ inches in diameter; the bottom for a 3-pint basin is cut 7 inches in diameter, and the bottom for a 2-quart basin is cut $6\frac{7}{8}$ inches in diameter.

PATTERNS FOR FLARING ARTICLES

The following patterns are for some of the many articles that are laid out by the conical method; among which is a flaring washbowl, such as is shown in Fig. 76, usually made from two pieces, with a wired edge at the top and a straight rim stand at the bottom. It is made from IC or IX bright tin plate, with locked seams. The method of obtaining the pattern is shown in Fig. 77, in which E J H I is the half-pattern. The pattern for the bottom is a circle struck with a radius

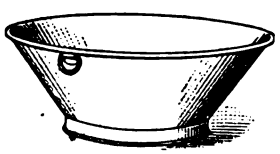


Fig. 76. Finished View of Bowl

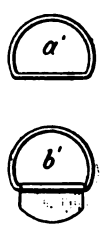


Fig. 78. The Ring

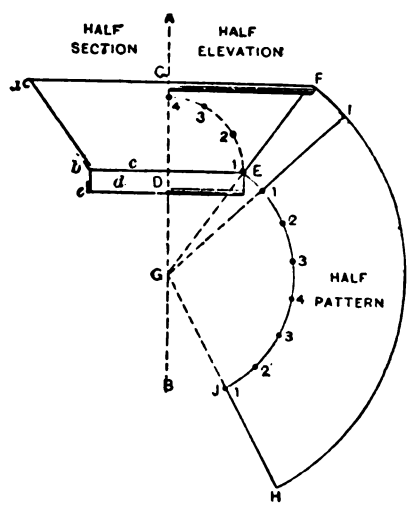


Fig. 77. Elevation and Pattern

equal to D 1, while the pattern for the lower rim is as high as shown, with a hem edge allowed equal in length to four times the quarter plan D 1 4.

To the left of the center line is shown the method of construction. The body has a wire edge at *a*, while the bottom *c* has a single edge, *b*, to which the body is soldered. The rim *d* has a hem edge at *e*, soldered raw edge to the bottom *c*. The

wire ring shown in Fig. 76 is made as shown in Fig. 78, in which *a'* represents the wire ring, while in *b'* the wire ring is shown with the clip attached, which is soldered to the body, allowing the ring to turn.

In the accompanying illustration, Fig. 79, is shown the method of obtaining the pattern for a round dish pan, which can be made in two or more pieces of IC or IX

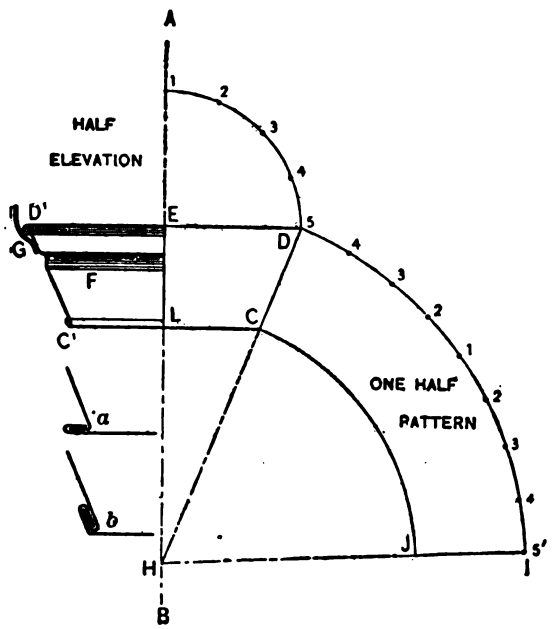


Fig. 79. Round Dish Pan

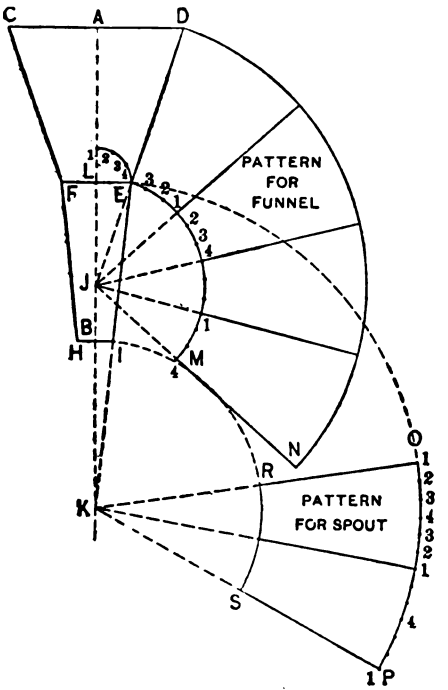


Fig. 80. Pattern for Funnel and Spout

Fig. 81. Perspective View

Fig. 83. Handle Pattern

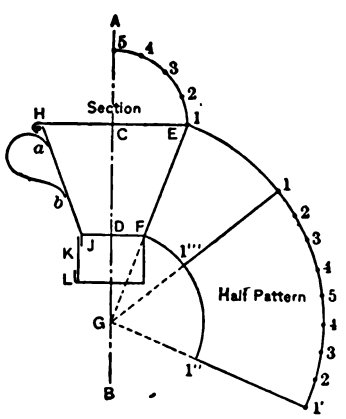


Fig. 82. Obtaining the Half Pattern

tin with grooved seams, the pattern of which, C D J I, is the one-half pattern for the dish pan. The bottom to the pan is double seamed. The first operation is shown by *a*, the second and final operation by *b*. D^1 E L C^1 shows a half elevation of the finished pan. Using the small beader, a bead is placed as at F. Tinned iron handles are riveted in position, as at G, and a wired edge is made at the top.

Another article is a funnel with spout, the drawing being made to avoid unnecessary lines and to simplify the work as much as possible, as shown by Fig. 80, in which both the funnel and spout are

developed similarly. The spout should have creases in it to allow the air to escape from a vessel that is being filled. These creases are best made, after the spout is formed into shape, by slipping over a suitable tool with grooves cut in it and dressing the metal of the tubes into these grooves with the peen of the hammer.

A simple piece of tinware which can be rolled up and soldered in spare time is a fruit jar filler, a finished view of which is shown in Fig. 81. These fillers are usually made from IC bright tin with locked seams and wired edge. The methods of construction and for obtaining the pattern are shown in Fig. 82; and the handle pattern is demonstrated in Fig. 83.

An article which can be made up for stock in different sizes is a dairy pail, shown in Fig. 84. It should be made of bright IC or IX tin, the body made in two pieces, and the bottom double seamed to the body. The ears are of malleable iron riveted to the body. The pails can be made with wooden handle on iron bail or with iron bail only. An ogee swedge may be turned near the upper part of the body, as shown in Fig. 85, which makes a neat appearance and strengthens the pail, and in which H I J K is the half pattern for the pail, to which allowance must be made for seaming and wiring, and with the bottom laid out with a radius equal to D E, strike the pattern for the bottom, shown by O P, to which edges have been allowed for double seaming at *a* and *b*. To the left of the line A B is shown the construction. L represents the wired edge, M the ogee swedge and N the doubled seams between the bottom and body.

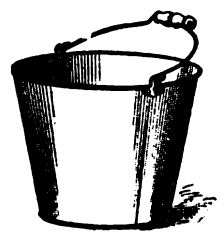


Fig. 84. Finished View of Pail

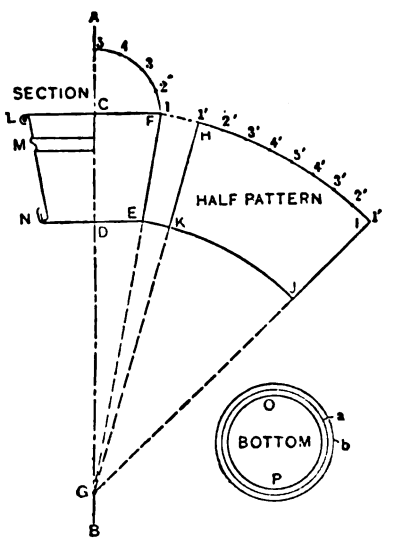


Fig. 85. Section and Patterns

A sap bucket with a hole at A for hanging it upon a support is shown in Fig. 86. The upper edge is wired at B and the bottom soldered or seamed at C. In Fig. 87 is shown how to develop the patterns. Laps are allowed on the sides for seaming and at the top for wiring. D in elevation shows the section of the wire, and C the edge of the bottom to be soldered to the body. With radius equal to *a* B, describe the disk F, to which an edge is allowed, as shown. A hole is punched in the pattern at 1, which is similar to A in Fig. 86. These buckets are usually made of IX tin.

When a flour sifter is to be constructed similar to the one shown in Fig. 88, the wire cloth *c* is usually brass or tinned wire, and $\frac{1}{8}$-inch thick rods (tinned) are

usually placed under the wire cloth to stiffen it, as indicated by the heavy lines *a* and *b*. The edge *d* is wired, and *e* is a groove in which the wire cloth is fastened by soldering. Of course, a better method of fastening the wire cloth to the body of the sifter, is to turn a small edge on the body, using the burr machine for this purpose, also turning an edge on the cloth. It is possible to turn this edge on the cloth, because it possesses sufficient stiffness; the cloth is now slipped on the body, the edges squeezed tight in the setting down machine, and this edge is double seamed by placing the sifter on the mandrel and throwing down the edge with a mallet. If the seam has a rounded appearance it is squared by inverting the sifter, and holding the edge of the seam on a square head stake, the seam is dressed with a mallet.

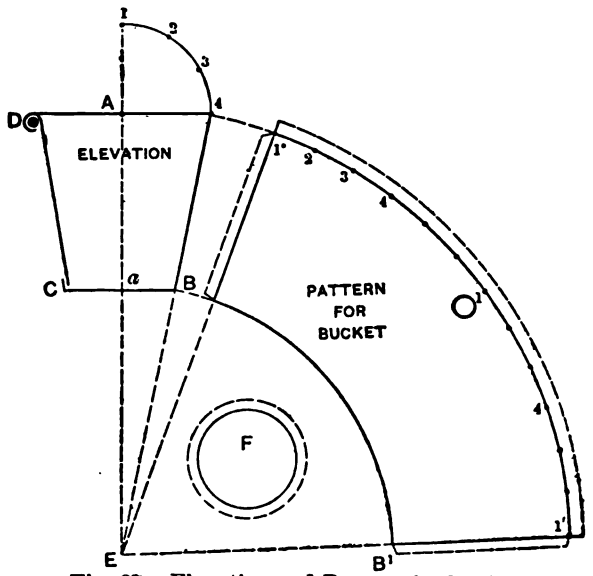


Fig. 87. Elevation and Pattern for Bucket

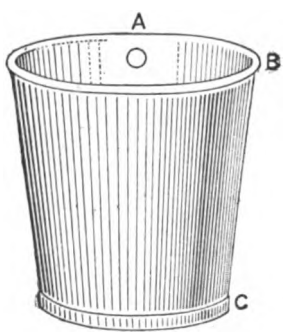


Fig. 86. View of Sap Bucket

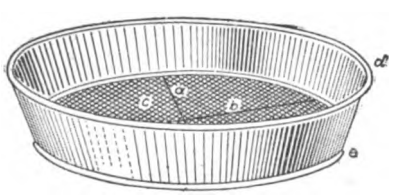


Fig. 88. Flour Sifter

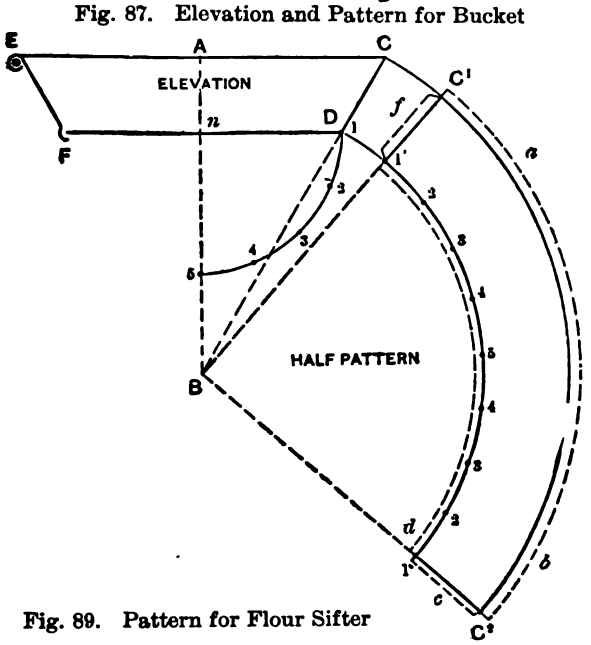


Fig. 89. Pattern for Flour Sifter

The pattern is obtained in the same way as the patterns for all flaring ware, as shown in Fig. 89. C^1 C^2 1° 1′ is the half pattern for the body of the sifter. An edge is allowed at *a b* for wiring E in elevation, also an edge along *e d* in the pattern for the groove or swedge F in elevation. The letters *c* and *f* are side seams.

PATTERNS FOR MILK STRAINER

The various forms of milk strainers are usually attached direct to the pails known as milk buckets or strainer pails. In Fig. 90 is shown a simple form of milk strainer placed directly over the can, and forming a cover which keeps out dust or insects until the can is filled and the cover replaced. In this cut A represents the upper portion of the milk can, broken at B to show a sectional view of the strainer C. It will be noticed that the edges are wired at *c c* and *d d*. The upper flaring piece, *c c* joins the lower flaring piece *d d*, forming a cover, which sets over the can, as shown. The inner cone, or strainer, *a b*, is soldered to the lower flaring piece, and has four circular holes cut into it in proportion to its size, about the same as shown in pattern M in Fig. 92. Over these holes, as shown by *a* and *b* in Fig. 90, fine wire cloth is soldered. The holes are cut above the apex of the cone, so that the sediment or dust, etc., has a chance to settle, and does not interfere with the straining of the milk.

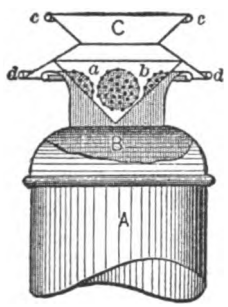


Fig. 90. Milk Strainer in Position

In Fig. 91, first draw the half elevation opposite the center line A B, as shown by C D E F G H I J K. Extend the sides D E and H E until they

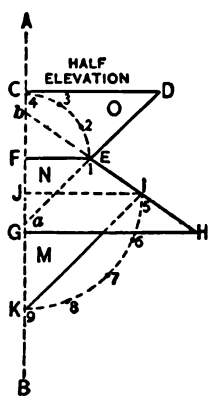
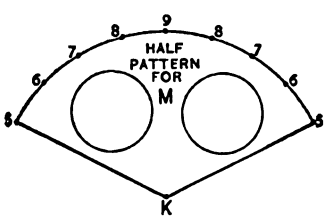


Fig. 91. Half Elevation and Radii



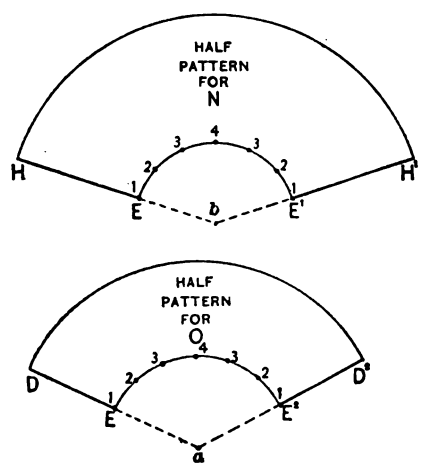


Fig. 92. The Pattern Shapes

intersect the center line A B at *a* and *b*. With F as center and F E as radius, describe the quarter plan on that line, as F E 4, which divide into equal parts, as

shown by the small figures 1, 2, 3 and 4. In similar manner, with J as center and J I as radius, describe the quarter plan J I 9, which also divide into equal spaces, as shown from 5 to 9. For the pattern for the inner cone, or strainer, M, use K I as radius, and, with K in Fig. 92 as center, describe the arc 5 5, on which lay off the stretchout of twice the number of spaces contained in the quarter plan 5 9 in Fig. 91, as shown from 5 to 9 to 5 in Fig. 92. Draw lines from 5 to K. Having done this much, K 5 9 5 K will then be the half pattern for the part designated M in Fig. 91.

At pleasure, draw two circles in the pattern M in Fig. 92, which cut out, and over the same solder circular pieces of tinned brass wire cloth. With radii equal to *b* E *b* in Fig. 91 and *b* in Fig. 92 as center, draw the arcs E E^1 and H H^1, respectively. From *b* draw any line, as *b* H, intersecting the inner arc at 1. Take the stretchout of the quarter circle 1 4 in Fig. 91 and place twice this amount on the arc E E^1 in Fig. 92, as shown from 1 to 4 to 1′. From *b* draw a line through 1′, intersecting the outer arc at H^1. Then will H H^1 E^1 E be the half pattern for N in Fig. 91. In a similar manner obtain the half pattern for O in Fig. 92, using the radii *a* E, *a* D in Fig. 91, and place twice the stretchout of the quarter plan 1 4 on the arc E E^2 in Fig. 92. Then will D D^2 E^2 E be the half pattern for O in Fig. 91.

PATTERNS FOR A DUST PAN

For a square cornered dust pan, the method for cutting the patterns is not difficult, and is as follows:

In Fig. 93 let A B C represent the side of the pan, and D E F G the view of the bottom on the line A C in side view. It is now necessary to obtain the miter line of the corners in the plan. With F in the plan as a center, describe the arc H I, so as to intersect the sides of the pan G F at H and F E at I. Then, with H and I as centers, and with any convenient radius, describe the arcs K and J respectively, intersecting each other at L. Also through L and F draw a line, extending it outward toward M. Intersect this by a line projected from the point B in side view. From M draw a line to G, thus completing the side of the pan in plan, as shown by G F M. In similar manner draw the opposite side D E N.

In the side view draw O P, the center line of the handle, so as to intersect the bottom of the pan and also the back at Y. At right angles to O P, draw the

line R S of the proper dimensions, and from R and S draw lines to the center O, intersecting the back and bottom of pan at Z and T and the bottom at C, respectively. To obtain a view of the handle in plan, which, however, is not necessary in the development of the pattern, proceed as follows: Through the center of the pan draw the line U V, then from the points O, T, R and S in

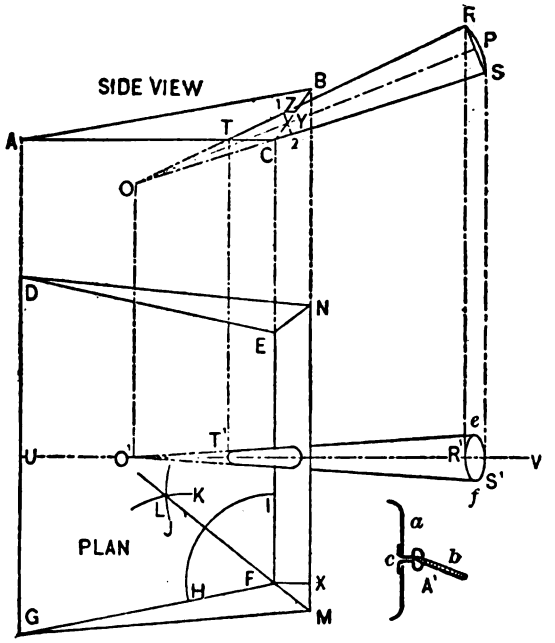


Fig. 93. Plan and Side View of Dust Pan

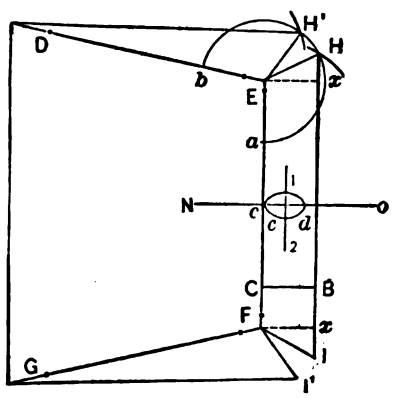


Fig. 94. Pattern for Pan

side view, drop lines intersecting the center line in plan at O^1, T^1, R^1 and S^1. Now take the distance from P to R in side view, and place it in plan, as shown on either side of the center line by *e* and *f*, and from these points draw lines to the center point O^1. The solid lines shown give the plan view of the handle.

For the pattern for the pan take a tracing of D E F G and place it as shown by D E F G in Fig. 94. Now take the distance from C to B in side view in Fig. 93, and place it as shown, at right angles to E F in Fig. 94 by C B. Through B, parallel to E F, draw the line H I. At right angles to E F, and from points E and F draw the lines E *x* and F *x*. Also take the distance from X to M in plan in Fig. 93, and place it as shown from *x* to H and *x* to I in Fig. 94, and draw lines from H to E and I to F. Now, with E as center and E H as radius, describe the arc *a b*. With *a* H now as radius and *b* as center, intersect the arc *a b* at H^1. Draw lines from E to H^1 to D. Trace similar miter on the opposite side, as shown by F I^1 G. Then will D H^1 E H I F I^1 G be the pattern for the pan.

Referring to the side view in Fig. 93, it will be noticed that the handle passes through the back of the pan and is soldered to the bottom at T C. For the opening to be cut into the back of the pan proceed as follows: Bisect the line E F

in Fig. 94 by N *o*, then take the distance from C to Z in side view in Fig. 93, and place it as shown on the line N *o* in Fig. 94, from *c* to *d*. Bisect *c d* and obtain the point *e*, through which, at right angles to *c d*, draw 1 2 indefinitely, as shown. And, at right angles to O P in side view in Fig. 93, and through the intersection Y, draw a line intersecting the sides of the handle at 1 and 2. Now take the distance from Y to 1 or 2 and place it in Fig. 94 from *e* to 1 and *e* to 2. Through 1 *d* 2 *c* draw the ellipse, through which the handle will pass.

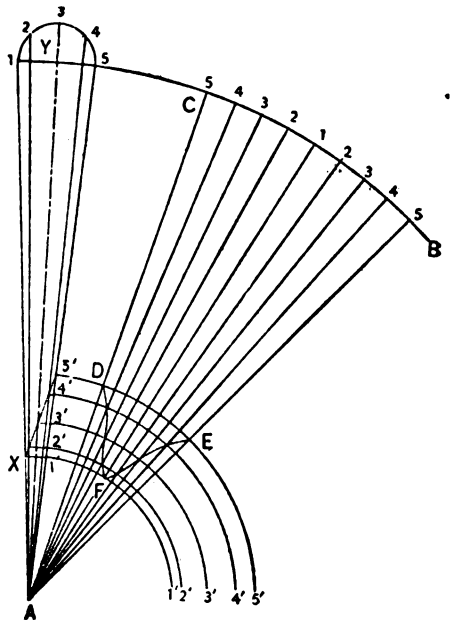


Fig. 95. Pattern for Handle, Enlarged

In Fig. 95 is shown the method of obtaining the pattern for the handle, which has been drawn on a slightly enlarged scale to better show the principle. Let A 5′ 5 1 *x* be a reproduction enlarged, of O C S R T in side view in Fig. 93. Place the semicircle 1 3 5 at the end of the handle in Fig. 95, which divide into equal spaces, as shown by the small figures 1 to 5. From these points, at right angles to 1 5, drop lines intersecting the base line 1 5, as shown. From these intersections draw lines to the apex A, intersecting the line X 5′, as shown. From these intersections, at right angles to the center line 3 A, draw lines intersecting the side of the handle 5 A at 1′ to 5′, as shown. Now with A as a center and radii equal to A 5, A 5′, A 4′, A 3′, A 2′ and A 1′, draw arcs, as shown. Draw any radial line, as C A. From C on the arc C B step off twice the number of spaces shown in the semicircle Y, as shown by the small figures 5 to 1 to 5 on C B. From these points draw lines to the center A, intersecting arcs having similar numbers, as shown. Trace a line through these intersections, as shown by D F E. Then will C B E F D be the pattern for the handle.

P in Fig. 93 shows a button on the handle slightly raised, on which a wire ring can be fastened to hang up. The wire ring can be fastened as shown in diagram A^1, Fig. 93, in which *a* is the raised button, *b* the wire ring, around which a strip ¼ inch wide, shown by *c*, is fastened. A slit ¼ inch wide is cut into the button with a small chisel, the strip passed through and turned over, as at *c*, which completes the pan. The corners are double seamed, or riveted and the edge wired or hem-edged.

PATTERNS FOR A SPONGE BATH

In Fig. 96 is shown a perspective view of a sponge bath, with seat, sponge holder and foot braces A and B. Baths of this kind are usually made from galvanized iron or heavy tin plate, or from zinc, which will not rust or tarnish.

In Fig. 97 is shown a half elevation, also a half sectional view, as well as the various patterns. Whatever size bath is required, draw the details and patterns by first drawing the center line, A B, upon which place the hights of the different flares, as shown by C D E. On either side of the center line A B, from the points C D E, place the semidiameters of the bath, as shown by H J, G K and F L. Then E F H C shows the half elevation, while E L J C shows the half sectional view, with wire edge at L, and edges at K and J for soldering purposes. L M shows the flare of the splash shield, which goes only a part way around the bath, as indicated in plan by b M^1 c. By N O L is shown the section of the foot brace, which can be made from the band iron which holds the galvanized iron sheets. One-half the plan of the bath is shown below the sectional view, the semicircles being struck from the center P, which represent the projections of the various flares, as shown by the dotted lines. By a b c d in plan is shown the seat, represented in the sectional view by e L K. By h i j k in plan is shown the sponge holder, while similar figures on the opposite side, or S H, show the soap holder, both being represented by m l L.

Fig. 96. The Sponge Bath

The pattern for the bottom of the bath is simply a circle with a radius equal to C H in elevation, allowing edges for soldering. For the pattern for the lower flare G H, extend this line until it meets the center line A B at R. With R as center, and R H and R G as radii, draw the arcs H^1 H^2 and S^1 G^1. Draw any radial line, as S^1 R, intersecting the inner arc at H^1. Now with D in the half elevation as center, and D G as radius, draw the quarter circle G S, which space into equal parts, as shown from 1 to 5, and transfer these spaces to the outer arc S^1 G^1 as shown, and draw the radial line from G^1 to R, cutting the inner arc at H^2. S^1 H^1 H^2 G^1 is the one-quarter pattern for the lower flare, the dotted lines being edges for seaming.

The pattern for the upper flare is obtained in a similar manner. F G is extended until it intersects the center line at T. Then, using T as center and T G and T F as radii, the arcs S^0 G^0 and F^1 F^2 are struck. On the inner arc, S^0 G^0, the girth of the quarter circle G S is placed. Radial lines are now drawn from T through S^0 and G^0, extending them until they intersect the outer arc at F^1 and F^2, respectively, which completes the one-quarter pattern for the upper flare, the dotted lines representing the edges.

For the pattern for the splasher shield extend M L in the sectional view until the center line A B is intersected at U. Then, with radius equal to U L, and U° as

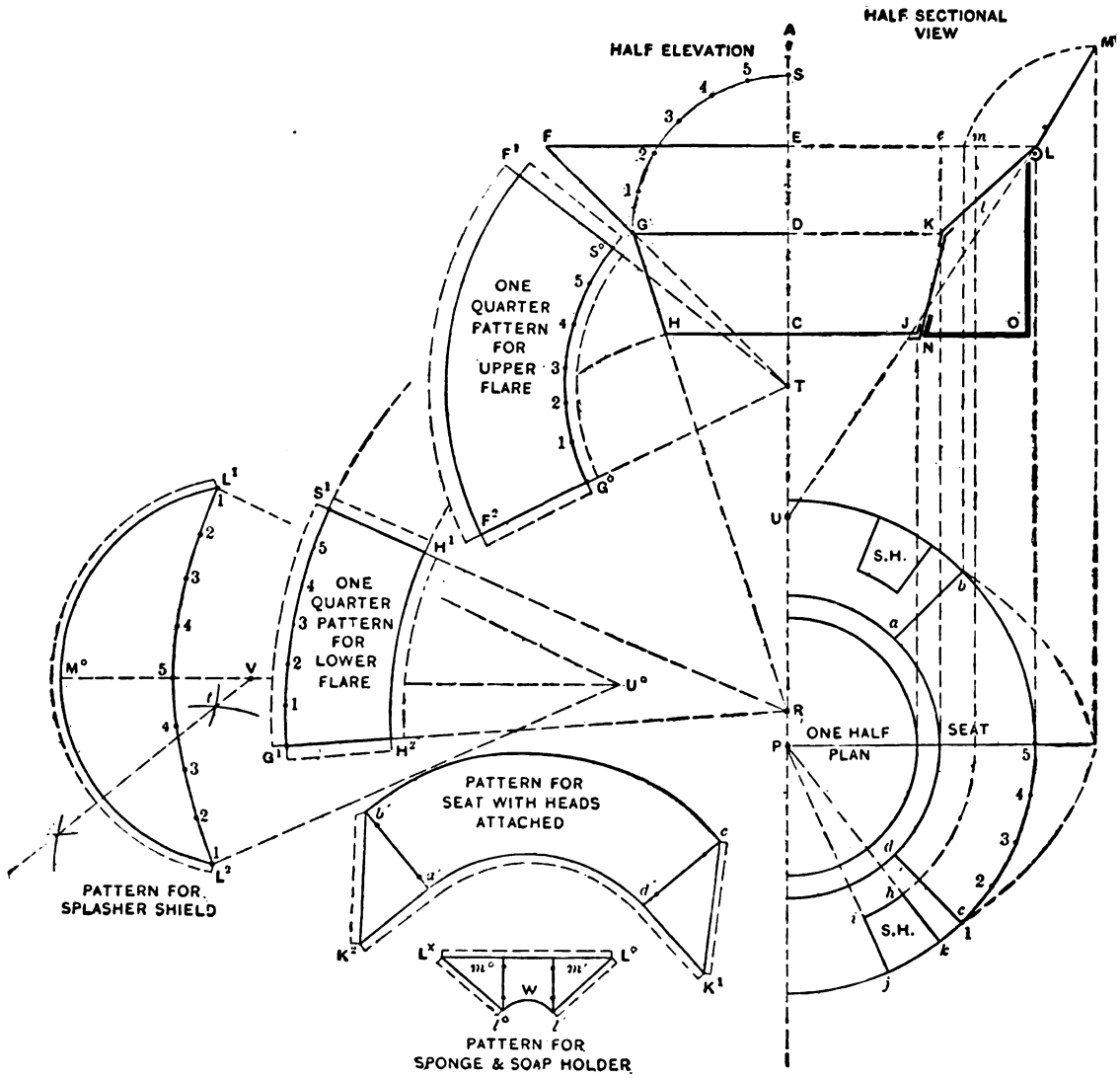


Fig. 97. Elevation, Plan, Section and Patterns

center, describe the arc L^1 L^2. As the shield is only to continue as far as from *b* to *c* in plan, obtain the girth of one-half of *b c*, or from 1 to 5, and place it as shown, from 1 to 5 to 1 on the arc L^1 L^2. Take the hight of the plane L M, in the sectional view, and place it on the line U° 5 extended, as shown from 5 to M°. With M° and L^2 as centers, and with radius more than half this distance, describe arcs, intersecting each other at *r* and *t*. Draw a line through *r* and *t* until it cuts the line U° 5 at V. Using V as center and V M°, or V L^2, as radius, describe the arc L^2 M° L^1, giving the pattern for the splasher shield, dotted lines being edges.

Take a tracing of the seat *a b c d* in plan and place it as shown by *a' b' c' d.'* On *c' d'* and *b' a'* and the heads K^1 and K^2, which are reproductions of L *e* K in the sectional view. In practice a wooden board is placed inside the seat, and a square bend made along *b' a'* and *c' d'*, then, if desired, the front of the seat, shown by *e* K in the sectional view, is soldered in position, with a width equal to *e* K, and length equal to the girth of *a' d'* in the pattern for seat. Edges are allowed for soldering, as shown. For the pattern for the soap and sponge holder take a tracing of *m l* L, in the sectional view, and place it as shown by *m' l'* L°. Reverse this as shown by *m°* *l°* L^x, making *m°* *l°* parallel to *m' l'*, and the distance between equal to *h i* in plan. This leaves the top of the holder open when formed up, as shown at *a* in Fig. 96. To allow the drip to run off, a curve is cut in Fig. 97, as shown at W. Edges along L^x L° are for wiring and soldering.

CONSTRUCTION OF A HOUSEMAID'S PAIL

The rule given in connection with the sponge bath in the preceding article can also be applied in developing the patterns for the housemaid's pail shown in perspective in Fig. 98. It will be noticed that the flaring pail A sets inside the flaring vessel B to prevent any overflow; C is an open tube to receive the brush, and D is a holder for the soap. These pails can be made from black iron, seamed and riveted and then galvanized after they are made. Fig. 99 shows the construction between the pail and dish, while A shows the horizontal section of the brush and soap holder, which are riveted to the pail. In turning the edges for the bottom on both the guard and the pail, it is necessary to first place the guard on the pail and turn both edges at one time. By using a stake that will fit tight in the guard, edges can be double seamed if desired.

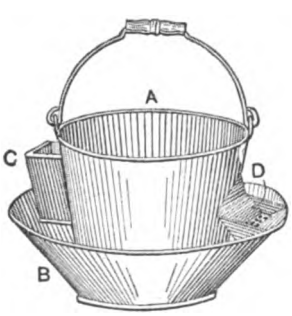


Fig. 98. View of Housemaid's Pail

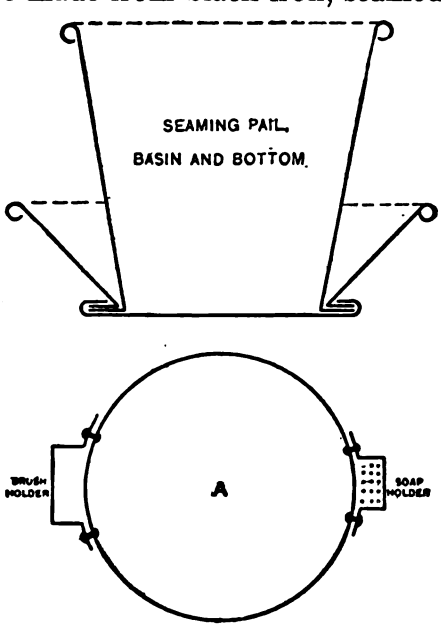


Fig. 99. Construction of the Pail

PATTERNS FOR TIN CHURN

In Fig. 100 is given a perspective view of a churn, in which A is the body, B the inverted cone cover, C the handle of the churners and D the churners, while *a* and *b* are cross pieces with perforations to better churn the contents in the up and down motion of the churner. This churn is best made from heavy tin plate, for the consensus of opinion is that zinc, or any galvanizing, affects such fluids as milk.

For the patterns for the various pieces proceed as is shown in Fig. 101, which is applicable to any size of churn. First draw the center line A B, upon which lay off the hight of the churn, as shown by *n m*. Then lay off the top and bottom diameters, F E and D C, respectively, and extend the sides D F and C E until they meet and intersect the center line at *b*. Now draw the bottom G, which make slightly concave, seaming it to the body at *a* and *a* and raising the bottom G on the wood block with the raising hammer. Also draw the cover H I J K in the form of an inverted cone, soldering a small tube in the center, as L M, to allow the handle S to work easily when churning. A double edge is allowed at P and R, to which the rim N O is seamed, fitting tightly into the top of the body, which is stiffened by the wire edge F E.

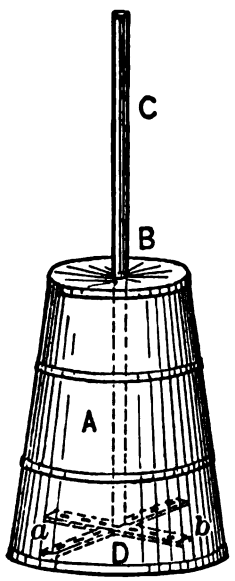


Fig. 100. Perspective View of Churn

By making the cover in the shape of an inverted cone, any fluid which escapes while churning flows back again into the churn through the tube L M. Extend the sides of the cover, I J and H K, until they meet and intersect the center line at *c*. Now, with *m* and *n* as centers, and radii equal respectively to *m* C and *n* I, draw the semicircles C 5 D and 1 4′ H, both of which divide into equal spaces, as shown respectively, by points 1 to 9 and 1′ to 7′. Then, with *b* as center and radii equal to *b* C and *b* E, describe the arcs C 9 and E U, and starting at any point, as 1, step off on the arc C 9 the stretchout of the semicircle D 5 C, as shown by similar figures on C 9. From 1 and 9 draw radial lines to the apex *b*, which intersect by an arc struck from *b* as center and *b* E as radius, thus locating the points T and U. Then will T U 9 1 be the half pattern for the body of the churn, to which laps are allowed for seaming and wiring, as shown.

For the pattern for the cover use *c*′ in X as center, and with radii equal to *c* J and *c* I in the sectional view, describe arcs in X, as shown by K^1 J^1 and 1′ 1″. Take the stretchout of the semicircle H 4′ I, and starting at any point, as 1′ on the outer arc in X, step off twice this amount, as shown from 1′ to 7′ to 1″.

From points 1′ and 1″ draw radial lines to c, intersecting the inner arc at K^1 and J^1. Then will K^1 J^1 1″ 1′ be the pattern for the cover, with laps allowed for double seaming.

W V in diagram Y shows a perspective of one of the churners, with double edges bent at d and e to stiffen the same. Holes are punched into the top, as shown, while X is the center hole, to which the metal tube C, in Fig. 100, is fastened. A wood bottom should be fitted under the bottom G in Fig. 101, also a heavy band iron hoop placed at the lower edge and top, also intermediate ones, as shown by Fig. 100, to secure stiffness, and especially the bottom one, prevent wearing of the body when moving the churn about. These hoops are made of ordinary band iron which is thoroughly tinned; and are secured to the body by riveting.

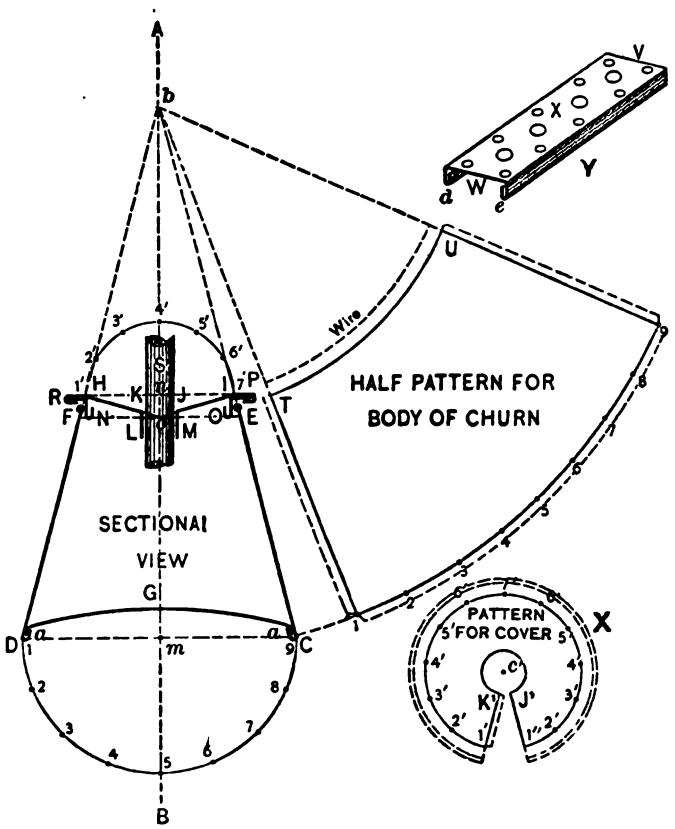


Fig. 101. Sectional Views and Patterns

PATTERNS FOR FLARING MEASURE WITH LIP

In Fig. 102 is shown a finished view of a lipped measure which requires four patterns—namely, the measure, lip, handle and grasp. These measures are usually made from bright IX tin, or copper tinned on the inside, usually the lip is wired at the top edge, also the top of the measure and the lip edged and simply soldered to body. The bottom is always double seamed on the body. Wire on both sides of the handle stiffen it and is riveted and soldered to the body.

As they must hold a given quantity and must be tested before they are sold, herewith is presented a table giving the hight, bottom and top diameters for different measures from 1 gill to 1 gallon:

Size	*Bottom Diameter, in Inches*	*Top Diameter, in Inches*	*Hight, in Inches*
1 gill	2.06	1.37	3.10
½ pint	2.60	1.73	3.89
1 pint	3.27	2.18	4.90
1 quart	4.12	2.75	6.18
½ gallon	5.18	3.45	7.78
1 gallon	6.55	4.35	9.80

Fractional Equivalents of Above
(Correct to $\frac{1}{32}$ in.)

Bottom Diameter in Inches.	*Top Diameter in Inches.*	*Hight in Inches.*
$2.06—2\frac{1}{16}$	$1.37—1\frac{3}{8}$	$3.10—3\frac{3}{32}$
$2.60—2\frac{19}{32}$	$1.73—1\frac{3}{4}$	$3.89—3\frac{29}{32}$
$3.27—3\frac{9}{32}$	$2.18—2\frac{3}{16}$	$4.90—4\frac{29}{32}$
$4.12—4\frac{1}{8}$	$2.75—2\frac{3}{4}$	$6.18—6\frac{3}{16}$
$5.18—5\frac{3}{16}$	$3.45—3\frac{15}{32}$	$7.78—7\frac{25}{32}$
$6.55—6\frac{9}{16}$	$4.35—4\frac{11}{32}$	$9.80—9\frac{13}{16}$

Assuming that a measure is to be made holding a given quantity, and knowing the size, first draw the vertical line A B in Fig. 103, upon which place the hight, as shown by *a b*. At right angles to A B, draw the top and bottom diameters, C D and F E, respectively, as shown. Extend the lines E D and F C respectively, until they meet the center line A B at A. At pleasure, draw the angle or flare of the front of the lip, as shown by *d* C, extending the line *d* C until it intersects the center line A B at *c*. From *c* draw a line through D and make D *e* equal to the hight of the back of the flare, which is established at pleasure, and draw a line from *e* to *d*. With *a* and *b* as centers, describe the half sections C 4′ D and F B E respectively, as shown, both of which divide into an equal number of spaces, as shown by points 1 to 7 and 1′ to 7′. At pleasure, draw the handle D *e f* J, and the grasp H.

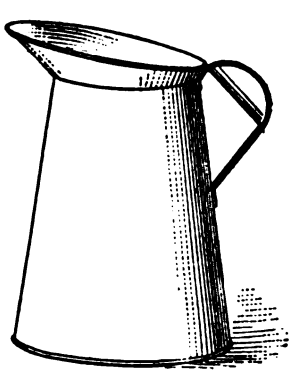


Fig. 102. Perspective View of Finished Measure

For the pattern for the measure use A as center, and with radii equal to A D and A E, draw the arcs E E^1 and D D^1. At any point, as F^1, draw a radial line to A, intersecting the arc D D^1 at C^1. Starting from F^1, lay off on the arc E E^1 the stretchout of the half circle F B E, as shown by similar figures on F^1 E^1. From the point 7, draw a line to the apex A, intersecting the arc D D^1 at D^1. Then will C^1 D^1 E^1 F^1 be the half net pattern for the measure.

For the pattern for the handle take a stretchout of D *e f* J and place it on the vertical line D^1 J^1, at right angle to which, through points D^1 and J^1, draw the top

and bottom width of the handle at pleasure, as shown by *m m* and *n n*, respectively. Draw lines from *m* to *n* on both sides; then will *m n n m* be the net pattern for the handle. The method for obtaining the pattern for the grasp H is shown in diagram U, in which N shows the side view of the grasp enlarged from H, and P the

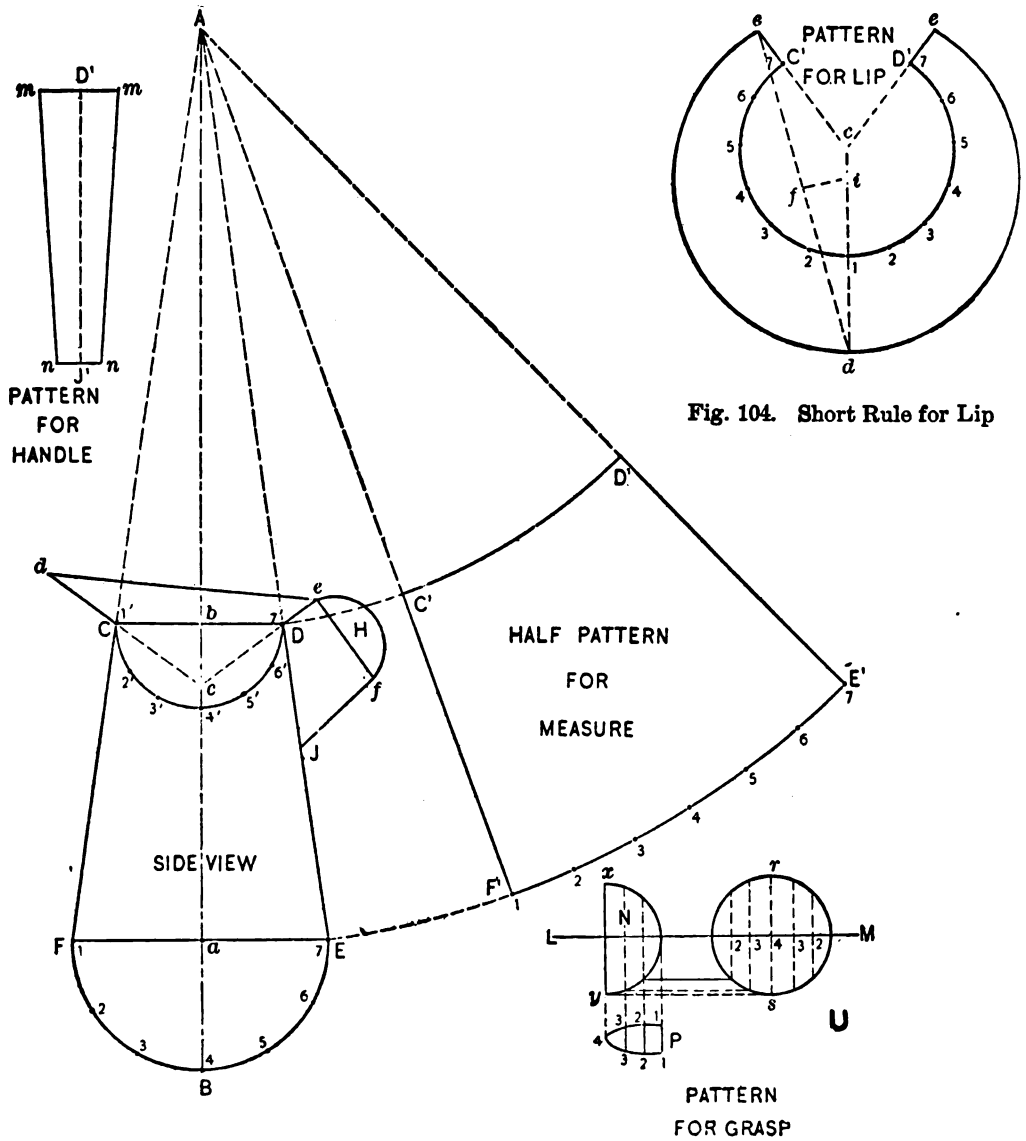


Fig. 104. Short Rule for Lip

Fig. 103. Elevation, Sections and Patterns

true section on the line L M, drawn through the center and at right angles to *x y*. Care should be taken to have distance 1 1 in section P no wider than the width of the handle at *f* in the side view. Divide the section P into an equal number of spaces, as shown by the points 1 to 4 on each side, from which, parallel to *x y*, draw

lines intersecting the curve of the grasp N, as shown. On the line L M lay off the stretchout of the section P, as shown by similar numbers on L M. Through these points, at right angles to L M draw lines, which intersect with lines drawn parallel to L M from similar intersections in the curve N. Trace a line, as shown by 1 *r* 1 *s*, which will be the net pattern for the grasp, edges not being necessary for soldering.

Although the lip *d* C D *e* in side view is a frustum of a right cone and can be developed by the cone method, a shorter rule which can be applied, and which answers the purpose just as well, is shown in Fig. 104. With radius equal to *c* D in Fig. 103, and *c* in Fig. 104 as center, describe the arc C^1 D^1. From *c* drop a vertical line *c d*, intersecting the arc just drawn at 1. Starting from the point 1, set off on either, the number of spaces contained in the half section C 4′ D in the side view in Fig. 103, as shown by similar numbers on the arc C^1 D^1 in Fig. 104. From *c* draw lines through the points 7 and 7, making 7 *e* on both sides equal to D *e* of the back of the lip in the side view in Fig. 103. Now take the distance of the front flare of the lip C *d* and place it, as shown, from 1 to *d* in Fig. 104. Draw a line from *e* to *d*, which bisect and obtain the point *f*. From *f*, at right angles to *e d*, draw the line *f i*, intersecting the center line *c d* at *i*. Then, using *i* as center and *i d* or *i e* as radius, describe the arc *e d e*, intersecting the radial lines *c e* and *c e* at *e* and *e*. Then will *e d e* D^1 1 C^1 be the net pattern for the lip; edges to be allowed for wiring and soldering to the body.

PATTERNS FOR A HIP BATHTUB WITH UPPER EDGE OF TUBING

A finished view of a hip bathtub is shown in Fig. 105. The material used in its construction is zinc or galvanized iron. Tubs made of black iron are usually enameled or japanned, with more or less stenciled or colored ornamentation; and those made of zinc are polished. In the illustration, *a a* is a flaring foot piece with a heavy wire edge, and *b b b* represents a heavy zinc bead placed along the top edge. Instructions are given farther on for making and applying this tubing; it is suggested however, that ordinary lead pipe would be equally advantageous for this purpose.

In Fig. 106 is shown how to obtain the pattern To do this first draw the center line J L, upon which place the hight of the bathtub, as shown from J to 5'.

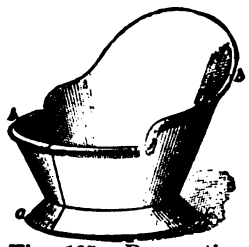


Fig. 105. Perspective View of Hip Bathtub

Through J and 5' draw horizontal lines, making J D, J I and 5' C, 5' B equal respectively, to the half diameters of the top and bottom. In similar manner draw the side elevation of the foot G B C H. Draw a line from I through B, and from D through C, extending them until they intersect each other in the center line at L. In similar manner extend G B and H C until they meet at N. At pleasure draw the desired curve D E A, thus completing the side elevation. So much having been done, the next step is as follows:

Using 5' as center, with 5' B as radius, draw the half bottom, or plan, B M C, which divide into equal parts, as shown from 1 to 9. From these points, at right angles to B C, draw lines intersecting B C at 1, 2', 3', etc. From the apex L draw lines through the intersections on B C until they intersect the upper

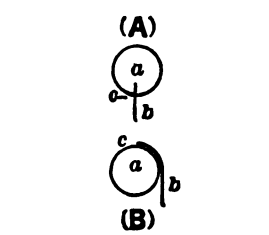


Fig. 108. Methods of Fastening Tube

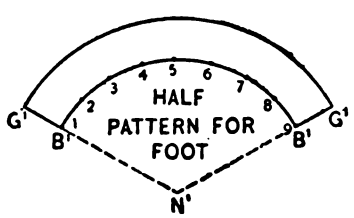


Fig. 107. Pattern for Foot

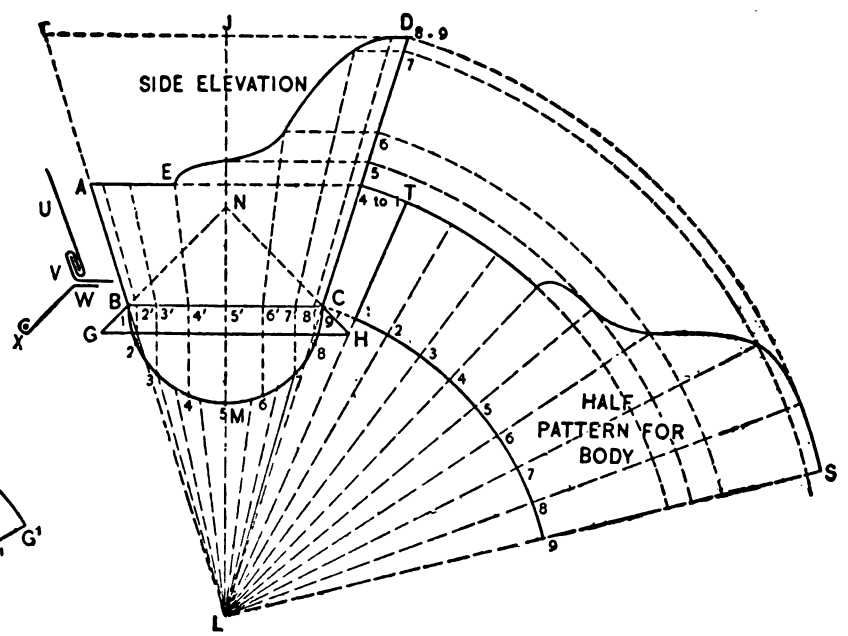


Fig. 106. Side Elevation, Section and Pattern

line of the tub A E D, from which points, at right angles to J L, draw lines intersecting D C at points 1 to 9, as shown.

Using L as center and with L C as radius, describe the arc H 9, upon which place the stretchout of the semicircle B M C, as shown from 1 to 9 on H

P. From L, through these small figures, draw radial lines, which intersect by arcs struck from L as center, with similarly numbered intersections on D C as radii. Through the points thus obtained, trace a line shown by H T S 9, which will be the half pattern for the body, to which edges must be allowed at the bottom for seaming to the body, as at V, and at the top for joining to the bead, as at (A) and (B) in Fig. 108. Also allow edge at T H in Fig. 106. B M C represents the half bottom, to which double edges must be allowed, as at V, for double seaming.

With radii equal to N B and N G, and with N^1 in Fig. 107 as center, draw the arcs G^1 G^1 and B^1 B^1. Take the stretchout of B M C in Fig. 106 and place it on the inner arc in Fig. 107, as shown. From N^1 draw lines through B^1 B^1, intersecting the outer arc at G^1 G^1, which completes the half pattern for the foot. Laps must be provided on the inner and outer arcs to allow respectively, for the flange W in Fig. 106 and the wire X.

The tubing for the upper edge of the tub is usually made from zinc. Knowing the diameter of the tubing, it is rolled up in straight lengths, lapped and soldered. One end is closed up, then the tubing is filled with hot white sand or melted rosin, after which it is formed to the required shape while warm. When the correct shape is obtained it may be fastened to the body, as shown in Fig. 108 in (A), by cutting a slot into the bead *a*, inserting the upper edge of the tub *b*, and then soldering at *c* on both sides. Another method is by flanging the tub *b* in (B), so that it lays snugly over the bead *a*; then soldering, etc., and scraping and sandpapering the upper edge at *c*. When the work is done it should present a smooth, clean surface. Under the bottom B C in Fig. 106, a wood bottom should be placed to stiffen it.

PATTERNS FOR COFFEE POT

It often happens that a customer desires some special piece of tinware made that is not kept in stock, such as a coffee pot of IXX tin. A perspective view of such an article is shown in Fig. 109. In developing the patterns, proceed as shown in Fig. 110. First draw any vertical line, as A B, upon which place the hight of the coffee pot, as B C. At right angles to B C, draw the top diameter D E and the bottom G F, placing one-half diameter of each on either side of the center line, as shown. Draw the lines D G and F E, extending F E until it intersects the center line A B at A. Then will A be the center point from which to strike the pattern. With B as center and B F as radius, draw the half plan of the bottom F 6 G, which

divide into equal spaces, as shown by the small figures 1 to 10. With A as center, and radii equal to A E and A F, draw the arcs J H and K I, as shown. From J draw a line toward the apex A, intersecting the arc K I at K. Starting from the point J, lay off on J H the stretchout of twice the amount of the half plan G 6 F, as shown by the small figures 1 to 10 to 1 on the arc J H. From H draw a line to the apex A, intersecting the arc K I at I. Then will I H J K be the pattern for the body of the pot.

Fig. 109. Perspective View of Coffee Pot

In its proper position draw the outline of the spout, as shown by L M N O, intersecting the body of the coffee pot D G at M and N, while L O represents the opening of the spout at the top. Extend the lines N O and M L until they intersect each other at P. Using P as center and P N as radius, describe the arc N 1′, which intersect by the line L M extended at 1′. Draw a line from N to 1′, which bisect and obtain the point *a*. Then, with *a* as center and *a* N as radius, describe the semicircle shown, which divide into equal spaces, as shown by 1′, 2′ and 3′. In practice, more spaces should be employed. At right angles to N 1′ and from 2′, draw a line intersecting N 1′ at *a*. From *a* draw a line to the apex P, intersecting D G of the pot at *b*, and O L of the top of the spout at *e*. Now, at right angles to the center line P *a*, and from the intersections at the bottom of the spout M *b* N, and at the top at L *e* O (which represent, respectively, points of intersections obtained from 1′, 2′, 3′ in the semicircle), draw lines intersecting O N of the spout at 1, 2, 3, at the top and bottom of the spout, respectively. Using P as center and radius equal to P N, describe the arc N S. At any point, as R, draw the line R P. Starting at the point R, set off twice the amount of spaces contained in the semicircle 1′ 2′ 3′, as shown by 3 1 3 on R S. From the points 3, 2, 1, 2, 3 on R S, draw lines to the apex P. With P as center and radii equal to P 3, P 2, P 1, P 1, P 2, P 3′, on O N of the spout, draw arcs intersecting radial lines of similar numbers, as shown. Trace a line through points thus obtained; then will *t u* S R be the pattern for the spout.

It will be noticed that the fact has not been taken into consideration that the spout intersects a round surface, but it is assumed that it intersects a plane surface, as D G. The difference in the pattern is so slight that it will not be noticeable in practice. Had the pattern been developed according to the true geometrical rule, it would present a problem of two cones of unequal diameters intersecting each other, and require a little time, while the short rule employed answers the purpose just as well where the spout is of so small a diameter.

For the pattern for the opening to be cut into the body to receive the spout, proceed as follows: From the point 10, or the center in the pattern for body, draw a line toward the apex A, intersecting the arc K I at 10′. From the intersections M *b* N between the spout and body, draw lines at right angles to C B, intersecting the opposite side of the body E F at M^1 *b*′ N^1. Then, using A as center and

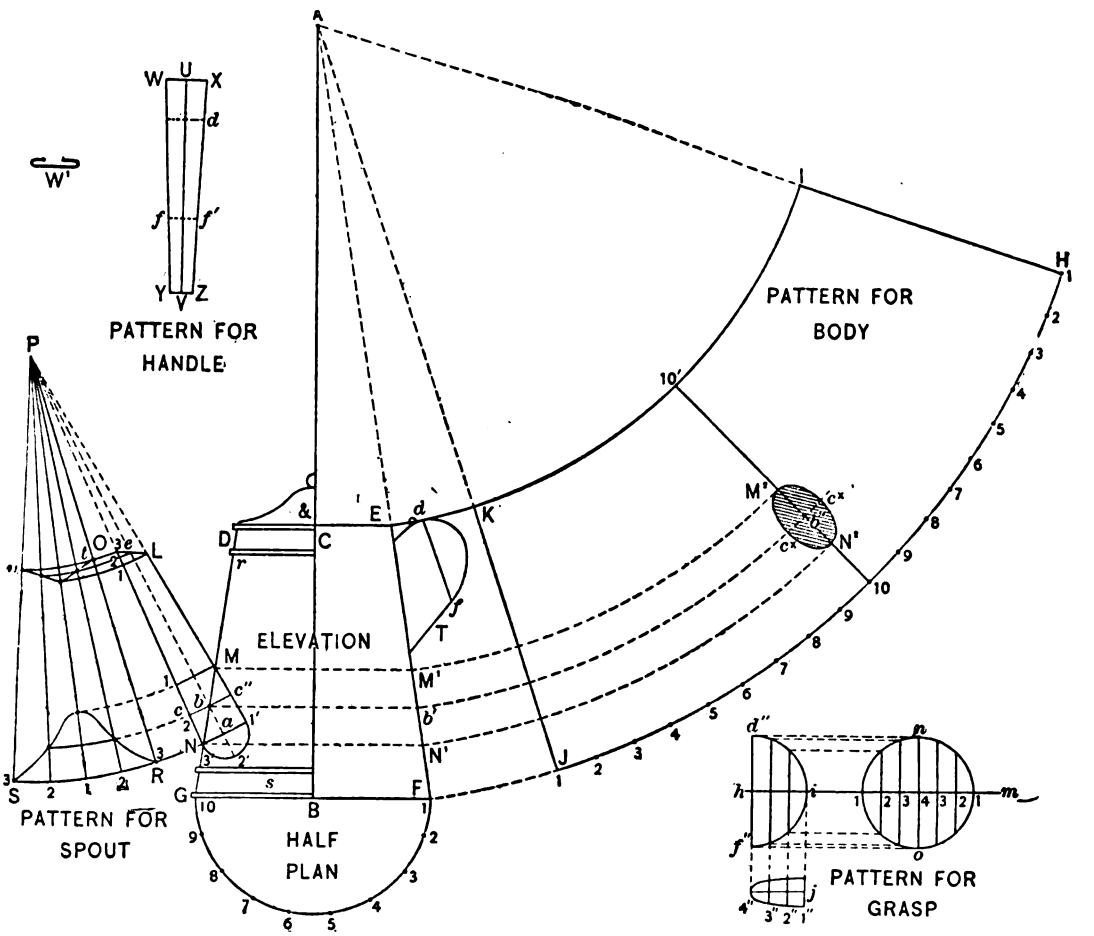


Fig. 110. The Pattern For Body, Spout, Handle and Grasp

with radii equal to A M^1, A *b*′ and A N^1, draw arcs intersecting the center line 10 10′ of the pattern at M^2, *b*″ and N^2. Through *b*″, at right angles to 10 10′, draw the line c^x c^x. Through the intersection *b* between the spout and the body, and at right angles to the center line P *a*, draw the line *c c*″, intersecting the sides of the spout O N and L 1′ at *c* and *c*″, respectively. Take the distance of either *b c* or *b c*″, and place it as shown, in the pattern for body from *b*″ to c^x on either side. A line traced through the points M^2, c^x, N^2, c^x, will be the required opening.

After the body is rolled up and seamed, a bead, shown at *r* and *s* in elevation, can be put in to make a neat finish, and incidently stiffen the body. The bottom G F is seamed in the usual manner, while the cover & is a pitched cover, with hinge attached, and can be made by hand by raising with a hammer and the hollowed out block of wood. The little knob can be purchased in most any hardware store. It is to be understood that the customary rim is to be seamed to the cover.

A plain flat handle is shown by *d* T, which is laid out by drawing any vertical line, as U V, upon which lay off the stretchout of *d f* T of the handle. At right angles to U V draw W X and Y Z, the width respectively, of the top and bottom of the handle, and draw the lines W Y and X Z. Then will W X Y Z be the pattern for the handle, to which a hem edge, as shown at W^1, should be allowed.

The grasp is shown by *d f* in elevation, and in an enlarged view by *d″ f″*, *j*, representing the true section through *h i*. Care should be taken that the width of *j* is not more than *f f′* in the pattern for the handle. Divide the profile *j* into an equal number of spaces, as shown by the small figures 1″ to 4″. From these points and at right angles to *h i*, draw lines intersecting the curve *d″ i f″*, as shown. Extend the line *h i* as *h m*, upon which place the stretchout of *j*, as shown by points 1 to 4 to 1 on *i m*. At right angles to *i m* and through the small figures, draw lines, which intersect with lines drawn from points having similar numbers in *d″ i f″*, at right angles to *d″ f″*. Trace a line through points thus obtained; then will *n* 1 0 1 be the pattern for the grasp. The letter *d* in elevation shows a small button which is soldered to the handle and prevents the thumb from slipping when in use.

PATTERN FOR RAISED BASIN

An article which is often required to be made up in copper, sheet iron or tin plate, is a raised basin, such as that shown in the finished view in Fig. 111. The wire hinge ring shown in the illustration is fastened to the basin by means of metal clip, as explained in previous articles. In getting out the pattern for the cove there is a certain rule, which, if followed, will bring the mold, when raised, to its proper desired dimensions at top and bottom, as shown in detail in Fig. 113. First draw the center line A B, upon which place the hight of the basin, as C D. From C and D draw horizontal lines, C E and D F, respectively, representing the half top and bottom diameters. With radius equal to *a* F, draw the cove F E, which completes the half elevation. Divide the cove F E into equal parts, as

shown by the small figures 1 to 7. Draw a line from F to E, which bisect and obtain *b*, from which point draw a line at right angles to F E, which will intersect 4 in the curve F E. From 4 draw a horizontal line, as 4 *c*, intersecting the center line A B at *c*.

The rule above referred to, to obtain true blanks for raised molds, was derived by experimenting extensively with various methods, rules and the like as adapted to circular cornice work. From these numerous tests it was found that the rule here presented is thoroughly practical and accurate. For additional information on raising work see Volume 6. Divide the distance from *b* to 4 into as many parts as the radius 4 *c* has inches. Any distance over ½ inch counts one, while of any distance less than ½ inch no account is taken. Thus, if the distance *c* 4 were 6⅝ inches, 7 would be taken; while if the distance were 6⅜ inches only 6 would be used. In this case, assume that the radius *c* 4 equals 4 inches. Then divide *b* 4 into four equal parts, as shown, and always through the first space *e* nearest the cove, draw a line parallel to F E, intersecting the center line A B at H, as G H. Now take the stretchout from

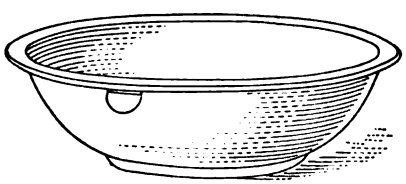


Fig. 111. Perspective View of Raised Basin

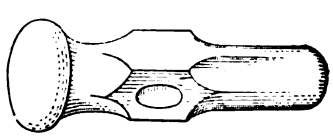


Fig. 112. Raising Hammer

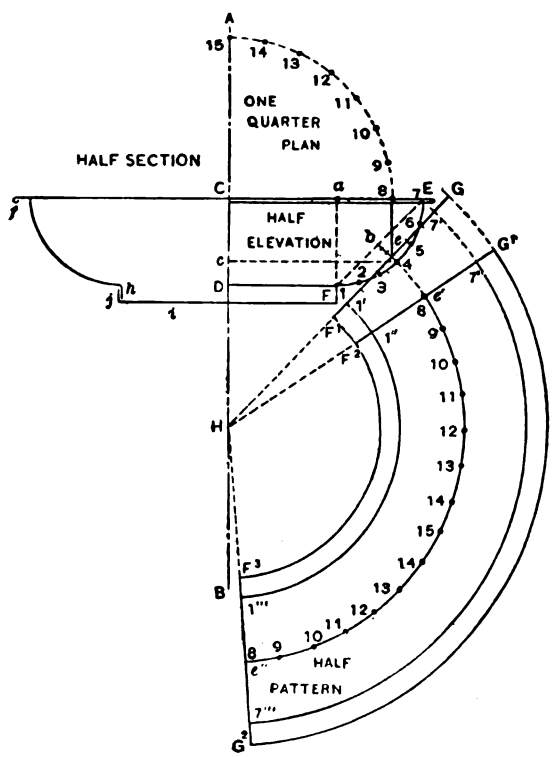


Fig. 113. Elevation and Pattern

4 to 1 and 4 to 7 and place it on the line G H, as shown respectively from *e* to 1′ and *e* to 7′. Then take the distance of the lower flange 1 **F** and the upper flange 7 E with the wire edge, and place it on the stretchout line G H, as shown respectively by 1′ F¹ and 7′ G. Then will G F¹ be the amount of metal required to form up by hand the mold E 4 1 F in the half-elevation. From the point *e*

erect a vertical line, intersecting the top line C E at 8; then, using C as center and C 8 as radius, describe the quarter plan 8 15, which is the quarter section on a horizontal line drawn from *e* in elevation. Divide the quarter plan into equal parts, as shown from 8 to 15.

For the pattern proceed as follows: Using H as center and radii equal to H F^1, H 1′, H *e*, H 7′ and H G, draw the arcs F^1 F^3, 1′ 1‴, *e e*″, 7′ 7‴ and G G^2. At any point on the outer arc, as G^1, draw a radial line to H, intersecting all the arcs drawn at 7″, *e*′, 1″ and F^2. Starting from *e*′, lay off on the arc *e*′ *e*″ twice the stretchout of the one-quarter plan, as shown from 8 to 15 to 8 on the arc *e*′ *e*″. From the center H draw a line through *e*″, intersecting the arcs previously drawn at F^3, 1‴, *e*″, 7‴ and G^2. Then will G^1 G^2 F^3 F^2 be the half pattern for the mold and flanges.

Before raising, the two halves are riveted together. They are then raised on the raising block, with a raising hammer of the required size, as shown in Fig. 112. When the mold is completed, it will be found that the top and bottom diameters are the desired size, resulting from the use of the rule above described. On the opposite side of the center line is shown the half section, showing the joints. Thus the top of the basin has a flange and wire edge at *f*, while the lower part has a flange, *h*, joining inside of the flange *j* of the bottom *i*. The radius for the bottom is shown by D F.

PATTERNS FOR A CHILD'S BATHTUB

In an accompanying illustration, Fig. 114, is shown a perspective view of a child's bathtub, made in two pieces, with seams at A and B on both sides. The top edge is wired, as shown at A in Fig. 115, and edged or double seamed, as shown at D. Draw the elevation of the tub, as shown by A B C D, and in its proper position below this draw the plan, as shown by E F, the semicircular ends being struck from the centers *a* and *a*. From *a* erect the vertical line *a* H, which intersect at H by the line B C, extended. Then H is the center with which to describe the pattern.

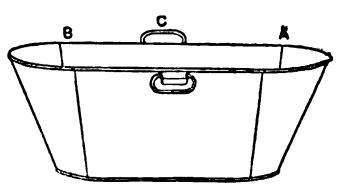


Fig. 114. Perspective View of Tub

Using H as center, and radii equal to H C and H B, draw the arcs *b b*′ and 1 9, as shown. From 1, on the outer arc, draw a radial line to the center H, intersecting the inner arc at *b*. Now divide the semicircle 1 9 in plan into equal parts, as shown, and place this

stretchout on the outer arc in the pattern, as shown from 1 to 9. From 9 draw a radial line to the center H, cutting the inner arc at b'. At right angles to 9 b', draw 9 10 and b' t, equal to 9 10 in plan. Then 1 10 t b is the pattern for 1 10 10′ 1′ in plan, with seams at 1 and 10. These seams are made by turning the ordinary lock edge, of the required size, and grooving, either with a hand tool or the many machines on the market.

Laps should be allowed to the pattern for seaming and wiring. The handle at C in Fig. 114 is made from rods of suitable size, with a tin clip clinched around it and is riveted, as shown. The inner plan in Fig. 115 is the pattern for the bottom of the tub, and to this edges must be added for seaming.

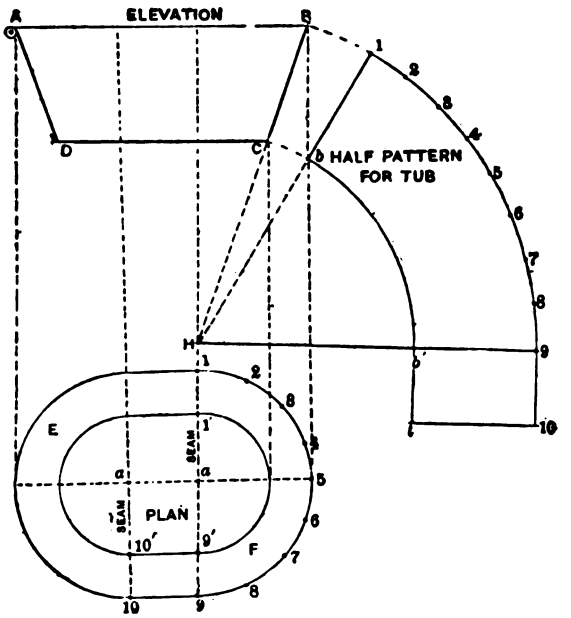


Fig. 115. Patterns for the Tub

PATTERN FOR SINK DRAINER

It is often the case that the trap under the kitchen sink is choked or blocked, owing to a collection of refuse matter. To avoid this a sink drainer is used. A perspective view of an article of this kind is shown in Fig. 116. This drainer is intended for use in the kitchen sink, being fastened through the wire loops A, B and C. The refuse matter is poured into the drainer, from which it is easily removed. It can be made of tin or black or galvanized iron, but where a good job is wanted it had best be made of 16-ounce copper.

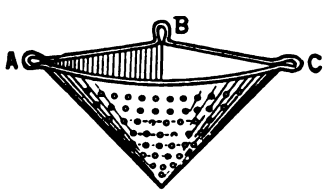


Fig. 116 Finished View of Sink Drainer

To obtain the pattern for any sized drainer proceed as follows: First draw the plan of the drainer, A B C in Fig. 117, which gives the size of the top opening. A B C is a right angle, the arc A C being struck from the center B. Directly above the plan draw the side elevation, as shown by D E F, making D E the

desired hight and E F equal to A B. Draw a line from F to D, which will give the flare of the drainer and radius with which to strike the pattern. Divide the arc A C in the plan into an equal number of parts, as shown from 1 to 6. Then, using D F in the elevation as radius, and D in Fig. 118 as the center, describe the arc 1 6. From any point in the arc, as 1, draw the line 1 D. Then, starting from the point 1, lay off on the arc 1 6 the stretchout of the arc 1 6 in the plan, Fig. 117, as shown by similar figures on 1 6 in Fig. 118. Draw a line from 6 to D. Then will 1 6 D represent

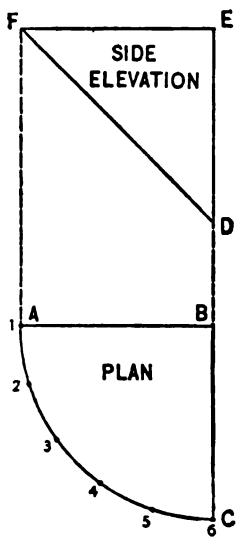


Fig. 117. Plan and Elevation

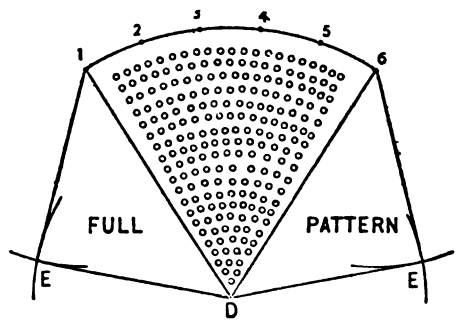


Fig. 118. The Pattern Shape

the front of the drainer shown in Fig. 116. Small perforations should be punched as shown in Fig. 118. With D E in Fig. 117 as radius, and D in Fig. 118 as center, describe the arcs E and E, which intersect with arcs struck from 1 and 6 as centers, and F E or A B in Fig. 117 as radius. Draw lines, as in Fig. 118, from 1 to E to D and D to E to 6. Then will 1 6 E D E 1 be the full pattern. Laps must be allowed for seaming at the corner B in the plan in Fig. 117, and edges for wiring at the top, allowing wire loops to project at the corners, A, B and C in Fig. 116.

PATTERN FOR OVAL PUDDING PAN

In making oval pudding pans of IX or IC tin, care must be taken to obtain a true pattern, so that when the pattern is formed up to the required shape it will be true to its profile and have a level line on top and bottom. However, before a pattern can be obtained, it must first be known how to construct the elliptical figure, so that a set of centers can be obtained with which to strike the arcs desired.

In Fig. 119 is shown the method of drawing an approximate ellipse to given dimensions. Let A B represent the length of the pudding pan, and C D its width. Take the distance of C D and place it from B on B A, as shown by the dot E.

Divide the distance E to A into three equal parts, as shown by 1 and 2. Take two of these parts as radius, or E 2, and with O as center, describe arcs intersecting the line B A at X and X^1. Then with X X^1 as radius, and using X and X^1 as centers, describe arcs intersecting each other at C and D. Draw lines from C to X and C to X', extending them toward F and G, respectively. In similar manner, from D draw lines to X and X', extending them toward I and H, respectively. With X and X^1 as centers and X A or X^1 B as radii, describe arcs intersecting the lines I D, F C, and G C, H D at J, K and L, M, respectively. In similar manner, with D and C as centers and D C and C D as radii, describe arcs which must meet the previous arcs at J M and L K, respectively, forming an approximate ellipse.

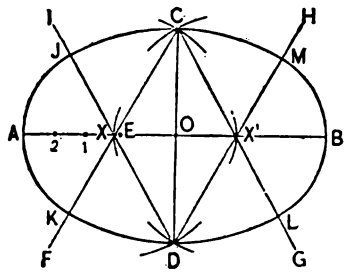


Fig. 119. Method of Drawing an Approximate Ellipse

In Fig. 120, let A B C D represent the side elevation of the pan, with a vertical hight equal to R C. In precisely the same manner as described in Fig. 119 draw the plan, as shown, in correct relation to the elevation, letting E F G H be the plan of the top of the pan, and J K L I the plan of the bottom, struck from the centers O, M, P and N.

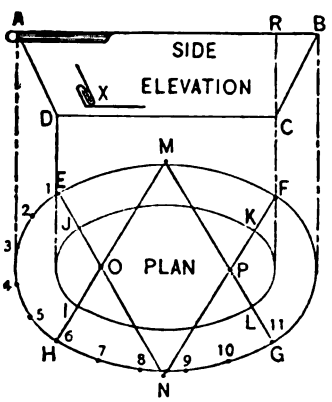


Fig. 120. Plan and Elevation of Pudding Pan

To obtain the radii with which to strike the pattern proceed as follows: Draw any horizontal line, R E in Fig. 121, equal to N E in plan in Fig. 120. Take the vertical hight R C in elevation and place it, as shown by R C in Fig. 121, on a line drawn at right angles to E R. Parallel to R E and from the point C, draw the line C J, equal to N J in plan in Fig. 120. Draw a line from E to J in Fig. 121, extending it until it meets the line R O at O. Then will O J and O E be the radii with which to strike the pattern for that part of the pan shown in plan in Fig. 120 by E F K J and G H I L.

Take the distance from P to F in plan, and place it, as shown from R to F in Fig. 121 on the line R E. In similar manner take the distance from P to K in plan in Fig. 120 and place it in Fig. 121 on the line C J, as shown from C to K. Draw a line from F to K, extending it until it meets the center line R O at P. Then will P K and P F be the radii with which to strike the pattern for that part of the plan shown in plan in Fig. 120 by K F G L and I H E J.

Next divide the curve from E H in plan into equal spaces, as shown by the small figures 1 to 6; also divide the curve H to G in equal spaces, as shown from 6 to 11.

For the pattern proceed as follows: In Fig. 122 draw any vertical line, as E O, and with radii equal to O J and O E in Fig. 121, and using O in Fig. 122 as center, describe the arcs J K and E F, as shown. Set the dividers equal to the spaces in H G in plan in Fig. 120, and starting from E in Fig. 122, step off the required number of spaces, as shown from 11 to 6.

From 6 draw a line to O, intersecting the curve J K at K. With P F in Fig. 121 as radius and F in Fig 122 as center, describe an arc intersecting the line F O at P. Then, using P as center and with radii equal to P K and P F, describe the arcs K L and F G, respectively, as shown. On the arc F G, starting from F or point 6, lay off the stretchout of H E in plan in Fig. 120, as shown by points 6 to 1 on the curve F G in Fig. 122. From 1 draw a line to P, intersecting the arc K L at L. Then will E F G L K J be the half pattern. If the pan is to be made in one piece, duplicate this half pattern opposite the line E J.

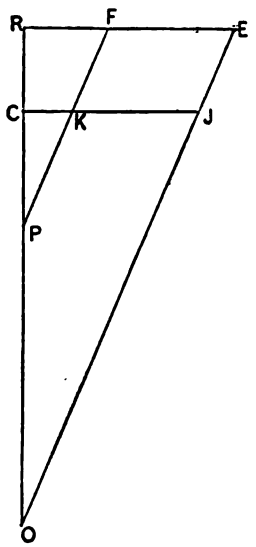


Fig. 121.—Obtaining Diagram of Triangles

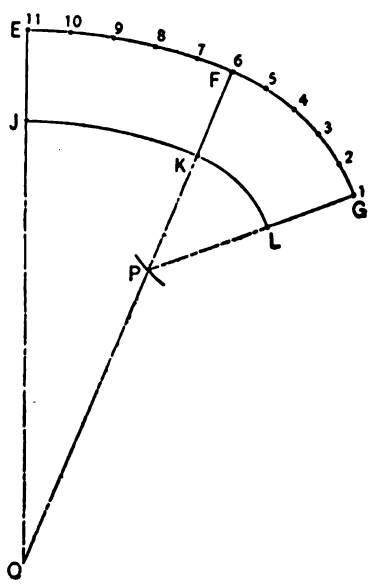


Fig. 122.—One-half Pattern Shape

Should the pan be desired in four sections, two pieces of the patterns, E F K J and F K L G, would be required. Allowance should be made for seaming and wiring. The bottom of the pan is shown by J K L I in plan in Fig. 120, which is double seamed to the body, similiar to X in the elevation.

PATTERNS FOR A BATHTUB

The following is an exemplification of the methods of obtaining the patterns of a sheet metal bathtub, in which Fig. 123 shows the finished view of the tub, which should be wired at B and double seamed to the bottom at C. In Fig. 124, D E 7 H C 12 is the plan of the bottom, and A F 8 G B the plan of the top, shown respectively by J K and I L in elevation. It will be noticed that the foot of the bath in plan has equal flare, as shown by A B C D, while the head has unequal flare, as shown by E F G H. The arcs are struck from the centers *a*, *b* and *c*, respectively.

From *a* draw the vertical line *a d*, which intersect at *d* by I J extended. Divide the quadrant C 12 into equal spaces, as shown by 9, 10, 11 and 12. From these points drop vertical lines, not here shown, intersecting J K in elevation at 9′ to 12′. From *d*, through these points, draw lines cutting I L, as shown. From these points draw horizontal lines, intersecting J I extended at 9″ to 12″. Using *d* as center, with *d* J as radius, draw the arc L M, upon which place the stretchout of 9 12, as shown. Through these points draw radial lines, which intersect by arcs, struck from *d* as center, with radii equal to *d* 9″, *d* 10″, *d* 11″, and *d* 12″. Then will L M N O be the pattern for the foot of the bath.

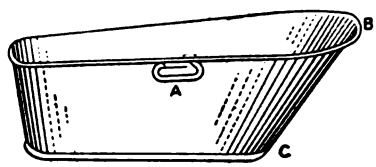


Fig. 123. The Bathtub

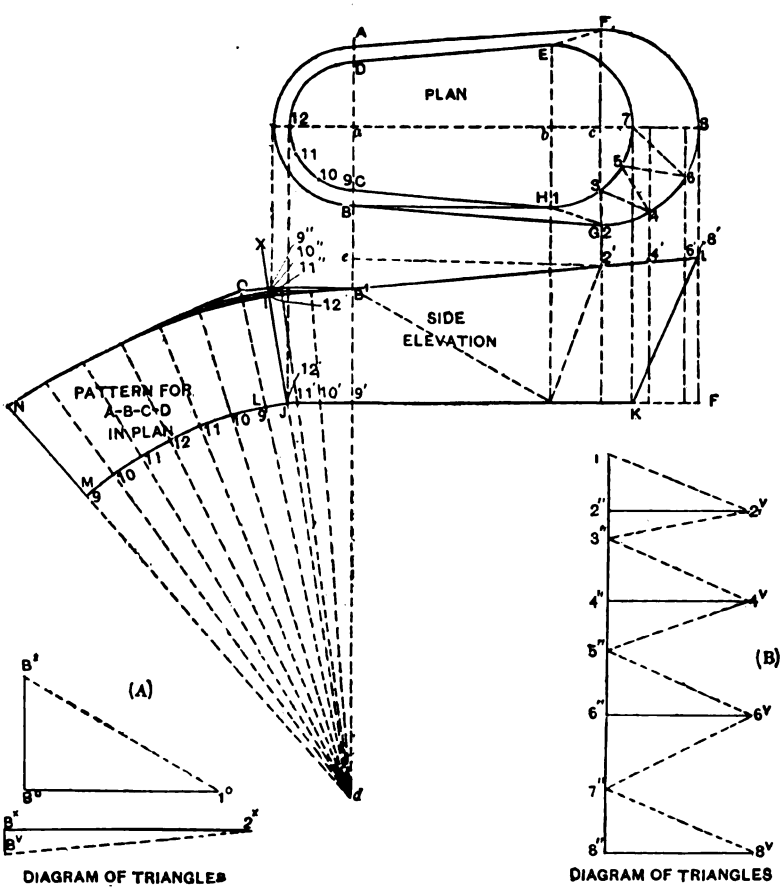


Fig. 124. Plan and Elevation, Diagram of Triangles and Pattern of Foot End

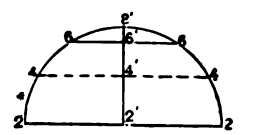


Fig. 125. Developed Section on 2′ 8′

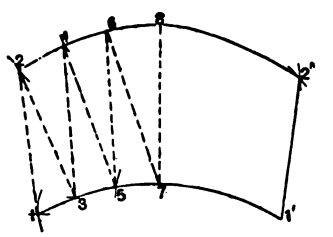


Fig. 126. Pattern for Head End

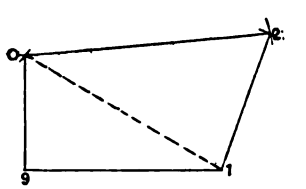


Fig. 127. Pattern for Side

The head of the tub is developed by triangulation. To do this, divide the half plans 7 H and 8 G both into equal parts, as shown from 1 to 7 and 2 to 8,

and draw dotted lines, as shown. From 2 to 8 drop vertical lines in the elevation, cutting I L and J K extended.

Take the various lengths in plan, as 1 2, 2 3, 3 4, etc., and place them on the vertical line 1″ 8″ in diagram B, as shown by similar numbers. At right angles to 1″ 8″, draw the lines 2″ 2^{v}, 4″ 4^{v}, 6″ 6^{v} and 8″ 8^{v}, equal in hight to 2′, 4′, 6′ and 8′ in elevation, measuring from the line J F. Connect the various points in diagram B, which represent the true lengths on similar numbered lines in plan.

As the top of the tub is not on a horizontal plane, a true section must be obtained on 2′ 8′ in elevation. Take the various distances 2′ to 8′, and place them on the vertical line in Fig. 125, through which draw horizontal lines. Measuring from the center line in plan in Fig. 124, take the various distances to points 2, 4 and 6, and place them on similar lines in Fig. 125 on either side of 2′ 8′. Then 2 8′ 2 is the developed section on 2′ 8′ in elevation.

Fig. 126 shows the pattern for the head. The distances on 1 1′ are obtained from 1 7 in plan in Fig. 124. The distances along 2 2′ in Fig. 126 are obtained from Fig. 125. The lengths of the lines in Fig. 126 are obtained from the triangles in diagram B in Fig. 124.

The pattern for the side C B G H in plan is also obtained by triangulation. C H shows its true length. To obtain the true length of H B and B G, proceed as follows: Take the distance 1 B and place it as shown by 1° B° in diagram A. Erect B° B^{2}, equal to 9′ B^{1} in elevation, and draw a line from B^{2} to 1° in A. In similar manner, take the distance from B to 2 in plan and place it in diagram A, as shown from B^{x} to 2^{x}. Draw B^{x} B^{v}, equal to *e* B^{1} in elevation, and draw a line from B^{v} to 2^{x}.

To develop the pattern, take the distance from 9 to 1 in plan and place it as shown from 9 to 1 in Fig. 127. With 9 as center, and 9 O in the pattern in Fig. 124 as radius, describe the arc O in Fig. 127, which intersect by an arc struck from 1 as center and 1° B^{2} in diagram A in Fig. 124 as radius. Then, with B^{v} 2^{x} as radius and O as center, in Fig. 127, describe an arc, which intersect by an arc struck from 1 as center and 1 2 in Fig. 126 as radius. Connect the points in Fig. 127, which is the pattern for the sides of the tub. Edges must be allowed for wiring and seaming.

PATTERNS FOR MILK BUCKET

To lay out a pattern for the milk bucket shown in Fig. 128, first draw the side elevation of the bucket, A B C D E F G, as at Fig. 129; also the plan view on

F E, as shown by K L M N, struck from the center I, through which erect the center line J C. Draw in its proper position to A G the true section on that line, O P R S. In line with the side elevation, draw the rear elevation of the bucket, T U V W X, the arc T U V being struck from the center *a*, and the distances Y W, Y X and 1″ V and 1″ T being equal, respectively, to H E and C D in the side elevation. The opening Z A^1 & G^1 represents the vertical section on A G in side elevation. Through the rear elevation draw the center line Y U, and divide the half curve U T into equal spaces, as shown by 1′, 2′, 3′ and 4′, through which draw lines intersecting the center line U Y at 3″, 2″ and 1″, and the curved line B C in side elevation (on which T U V in rear is a vertical section) at 1‴, 2‴, 3‴ and 4‴.

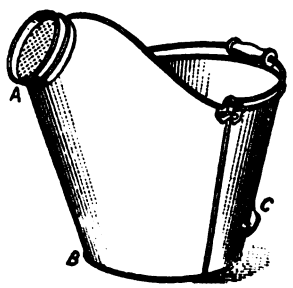


Fig. 128. Perspective View of Milk Bucket

It now becomes necessary to obtain a developed section on the curved line B C, for which proceed as follows: Extend the line Y U in rear elevation, as shown by U A^1, upon which place the stretchout of the curved line B C, as shown by 1⁗ to 4⁗ on A^1 U, through which draw horizontal lines, as shown, which intersect by lines drawn from similar numbered intersections in T U at right angles to T V. Trace a line through points thus obtained; then will 4⁗ 1° 1⁗ be the half developed section, which can be traced opposite the center line to complete the full section.

As a bucket of this kind is usually made in two pieces, with a seam at the sides, as shown in Fig. 128, first develop the rear of the bucket, as shown in Fig. 129. Extend the line D E in side elevation until it intersects the center line at J; then, using J as center and radii equal to J E and J D, draw the arcs E E^2 and D D^2. At any point, as D^1, on the arc D D^2, draw a line to the apex J, intersecting the inner arc at E^1. Divide the half plan K L M into equal parts, as shown from 1 to 7. Set the dividers equal to one of these spaces, and, starting from E^1, step off six parts, as shown from 1 to 7. Through 7 draw a line to J, extending it until it intersects the outer arc at D^2. Then will D^1 D^2 E^2 E^1 be the pattern for C D E H in side elevation.

The pattern for the part shown by A B C H F G will be developed by triangulation. To avoid a confusion of lines, the diagram shown in Fig. 130 is a reproduction of part of Fig. 129. Transfer the points 2‴ and 3‴ on Fig. 129 to Fig. 130, as 6′ and 7′. Take tracings of the half sections H E D C and S O P,

also the quarter plan N I M, and place them on similar lines in Fig. 130, on which they represent sections, as shown respectively by H 9′ 8′ C, G 3 A and F H 9. Divide the section F 9 into three equal parts, and as B C contains three spaces, divide the section G 3 A into six parts. Number these intersections, as shown. At right angles to G A and H F, and from the various intersections on G 3 A and 9 F, draw lines intersecting their base lines, as shown. Connect

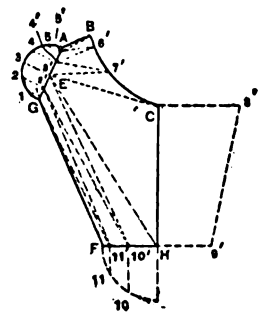


Fig. 130. Obtaining Measurements for Sections

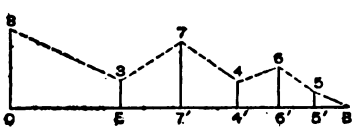


Fig. 131. Sections Represented by Dotted Lines on A B C E

Fig. 132. Sections Represented by Dotted Lines on E H F G

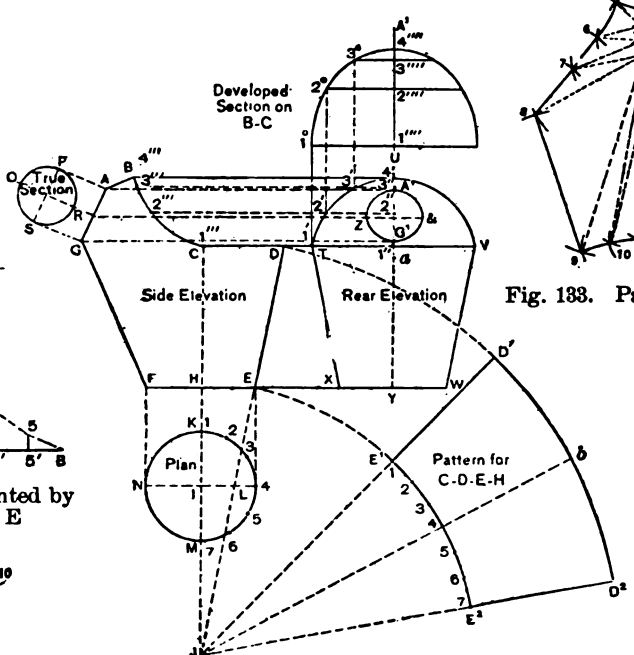


Fig. 129. Plan, Elevations, True Section and Pattern

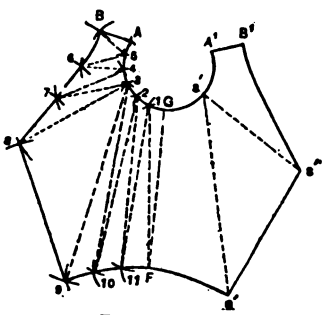


Fig. 133. Pattern for the Front

Fig. 134. The Strainer

opposite points, as B to 5′ to 6′ to 4′ to 7′, etc., as shown. Then will these lines represent the bases of sections which will be constructed, the altitudes of which are equal to the various hights in the sections. For example, take the distances of C E and E 7′ and place them, as shown, on the horizontal line C B in Fig. 131 by C E and E 7′, from which points, at right angles to the horizontal line, erect the lines C 8 and E 3 equal to C 8′ and E 3 in Fig. 130, and erect 7′ 7 in Fig. 131 equal in hight to 2′′′′ 2° in the developed section in Fig. 129. Then draw lines from 8 to 3 to 7 in Fig. 131, which represent the true lengths on similar numbered lines in Fig. 130. Proceed in this manner for the balance, as shown in Fig. 131, which represent the true lengths of the dotted lines shown in A B C E in Fig. 130. The true lengths of the dotted lines in E H F G are determined by the same method, the diagram of sections being shown in Fig. 132. In this the lines are drawn inside of one another to save space.

For the pattern proceed as is shown in Fig. 133. Draw G F equal in length to G F in Fig. 130. Using G 1 as radius and G in Fig. 133 as center, describe the arc 1, which intersect by an arc struck from F as center and F 1 in Fig. 132 as radius. Using as radius F 11 in Fig. 130, and F in Fig. 133 as center, describe the arc 11, which intersect by an arc struck from 1 as center and 1 11 in Fig. 132 as radius. Proceed in this manner, using alternately as radii, first the divisions in G 3 E in Fig. 130, then the length of the slant lines in Fig. 132, the divisions in F 8 in Fig. 130, and again the proper slant line in Fig. 132, until the line 3 9 in Fig. 133 is obtained. Using 9 as center and 9′ 8′ in Fig. 130 as radius, describe the arc 8 in Fig. 133, which intersect by an arc struck from 3 as center and 3 8 in Fig. 131 as radius. Then, starting from the point 8 in Fig. 133, proceed in similar manner as before, using alternately as radii first the division in the developed section starting at 1° in Fig. 129, then the length of the slant lines in Fig. 131, the divisions in E 3 A in Fig. 130, then again the length of the proper line in Fig. 131, until the line B A in Fig. 133 has been obtained, which is equal to B A in Fig. 130. Then will A B 8 9 F G A in Fig. 133 be the half pattern. Trace this half opposite the line G F, as shown, forming the pattern for the front of the bucket. Edges should be allowed for wiring and seaming.

The pattern for the bottom is shown by K L M N in plan in Fig. 129, to which edges must be allowed for double seaming to the body at B in Fig. 128. Cut out a lift, such as is shown at C in Fig. 128, to be soldered to the bucket where shown. Fig. 134 shows the construction of the strainer at A in Fig. 128. Although made in various ways, this is perhaps the simplest. A in Fig. 134 represents the mouth of the bucket, on which the collar *a*, 1 inch wide, is soldered. Roll up another collar about 2 inches wide, with a hem edge at *d* and a swedge turned outward, as at *c*. Make this collar of such size that it will make a tight joint over the collar *a* at *b*, but so it also can be taken off for cleaning. Cut a disk of wire cloth of the required diameter, as *e e*, which fit into the swedge *c* and solder. Putting on the handle completes the bucket.

PATTERNS FOR A TWO-PIECED COAL HOD

A finished view of a two-pieced coal hod, with seams at the sides, is shown in Fig. 135. To make this article proceed as follows: First draw, as in Fig. 136, the center line 9 A, and with any point, as L, for center, describe the circle 1 *a d* 4, representing the bottom of the hod. Through L, at right angles to 9 A,

draw the line B 12. Establish the projection of the back flare of the hod in plan, as shown by d 12, and with L as center and L 12 as radius, describe the semicircle, intersecting the center line at 5 and 9. Then, at pleasure, draw the plan view of the front and sides of the coal hod, as shown by 5 8 8^v 9. Directly below the plan draw the elevation of the hod, as shown by 8′ 5′ 12′ d' 1′, projecting all points from the plan, as shown by the dotted lines. The curve 8′ 5′ in the elevation at the top of the hod can be drawn at pleasure. Draw the elevation for the foot, or base, as shown by 1′ j i d', which completes the plan and elevation of the coal hod, this of course, being essential for the developing of the patterns.

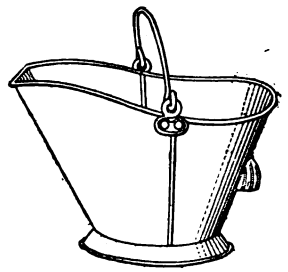


Fig. 185. View of Completed Hod

The patterns will be developed so that the seams will be at the sides, as shown in plan and elevation. For the pattern for the back of the hod, which will be developed by the radial line, proceed as follows: Extend the line 12′ d' in elevation until it intersects the center line 9 A at A. Then, using A as center and radii equal to A d' and A 12′, describe the arcs 12′ 5 and d' d'''. From any point, as 9′ on the arc 12′ 5, draw the radial line to A, intersecting the arc d' d''' at d''. Divide the semicircle 9 12 5 in plan into an equal number of parts, as shown by the small figures, and, starting from 9′ on the arc 12′ 5, step off the stretchout of 9 12 5 in plan, as shown by similar figures on the arc 9′ 5. From 5 draw a radial line to A, intersecting the inner arc at d'''. Then will 9′ 5 d''' d'' be the pattern for the back of the hod.

For the pattern for the foot, or base, extend the lines i d' and j 1′ until they intersect at l. Using l as center, with radii equal to l d' and l i, and l' in N as center, describe the arcs i' i'' and 4″ a'. From any point, as i'', draw the radial line to l', intersecting the inner arc at a'. Divide one-half of the small circle in plan into an equal number of spaces, as shown by a to f to 4, and, starting from a' in N, step off on a' 4″ the stretchout of one-half of the small circle in plan, as shown by similar letters in N. From l' draw a line through 4″, intersecting the outer arc at i'. Then will i' i'' a' 4″ be the half pattern for the foot.

The pattern for the front and sides, 5 8 8^v 9 in plan, will be developed by triangulation. As both sides of the hod are symmetrical, the pattern for one side only will be struck, from which the opposite side can be traced. In plan divide the space 8 to 5 into an equal number of parts, as shown by the figures 5, 6, 7 and 8. In the same manner divide the quarter circle 1 to 4 into the same number of equal parts, as shown by the small figures 1, 2, 3 and 4. Draw solid lines

from 1 to 8, 2 to 7, 3 to 6 and 4 to 5, and dotted lines from 1 to 7, 2 to 6 and 3 to 5. From the intersections 1, 2, 3 and 4 project vertical lines, not shown, to similar part in elevation, locating the points 1′, 2′, 3′ and 4′. In a similar manner, from points 5, 6, 7 and 8 drop vertical lines, as shown, intersecting the curved line at the top of the hod in elevation at 5′, 6′, 7′ and 8′. If desired, the points can be connected in elevation by means of solid and dotted lines, as shown, although this is not necessary.

Then will the solid and dotted lines in the plan represent the bases of triangles which will be constructed, vertical hights of which are equal to points having

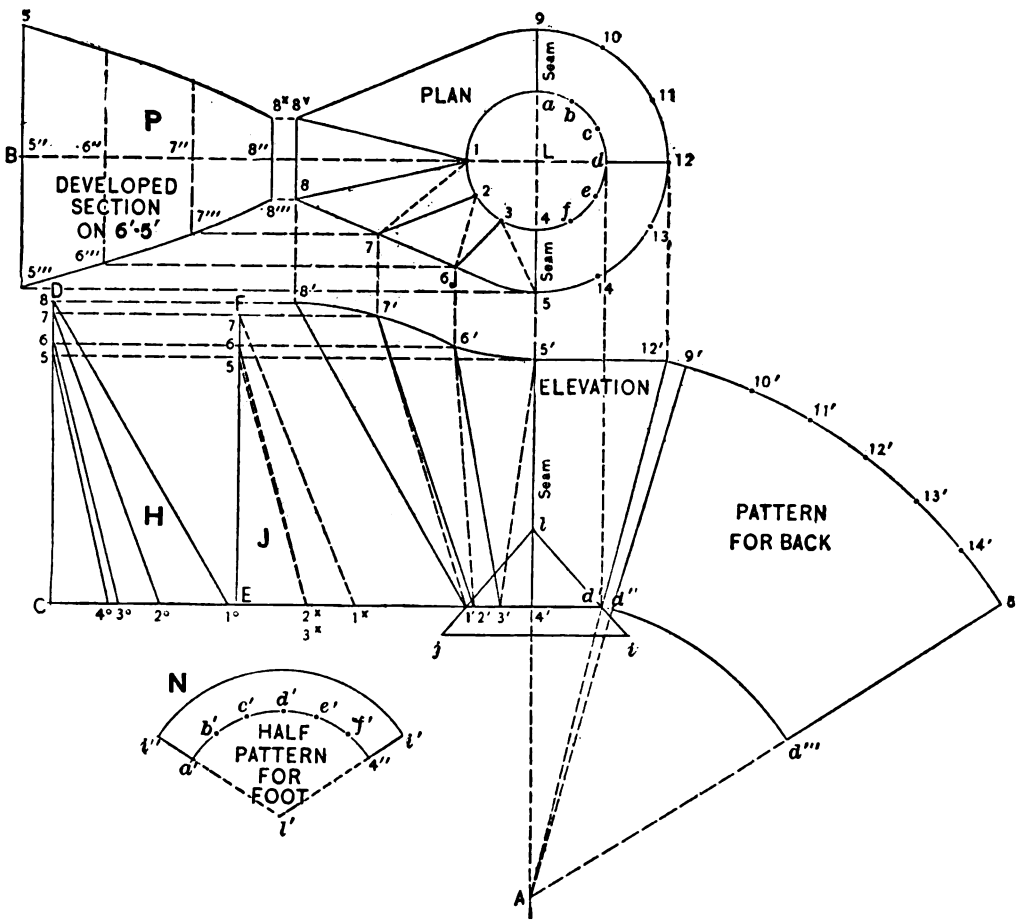


Fig. 136. Plan, Elevation, Developed Section, Diagram

similar numbers in elevation. For the triangles on solid lines proceed as is shown in H. Extend the line d' 1′ in elevation, as shown by d' C. From C erect the perpendicular line C D. Then, from the points 5′, 6′, 7′ and 8′ in elevation, draw horizontal lines intersecting the vertical line D C at 5, 6, 7 and 8. Take

the various distances in plan, 8 to 1, 7 to 2, 6 to 3 and 5 to 4, and place them in H on the line C d', measuring in each instance, as shown, from C to 1°, 2°, 3° and 4°, and draw lines from 1° to 8, 2° to 7, 3° to 6 and 4° to 5, which will represent the true lengths on similar numbered lines in plan.

In a similar manner obtain the triangles on the dotted lines in plan. From any point, as E in J, erect the vertical line E F, intersecting the horizontal lines previously drawn from 5′ to 7′ at 5, 6 and 7. Take the various distances of the dotted lines in plan, 7 to 1, 6 to 2 and 5 to 3, and place them in J, as shown, from E to 1^x, E to 2^x and E to 3^x. Draw dotted lines from 7 to 1^x, 6 to 2^x and 5 to 3^x, which represent the true lengths on similar numbered lines in plan.

It is now necessary to obtain a developed section on the curve 5′ 8′ in elevation, so that the true lengths on this curb can be obtained. On the center line B 12 in plan, lay off the stretchout of the curve 5′ to 8′, as shown by similar figures 5″ to 8″ on B 12. At right angles to B 12 and through these points draw lines, as shown, which intersect by horizontal lines drawn from similar numbered points on 5 8 in plan, resulting in the intersections 5‴ to 8‴. Through these points trace a line, as shown. In this case the opposite side has been traced, which is not necessary in practice. Then will 5^x 5‴ 8‴ 8^x be the developed section or the cover to close the opening on 5′ 8′ in elevation, if it may be stated in that way.

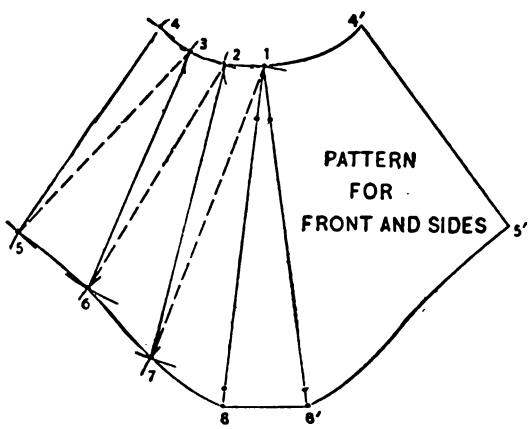


Fig. 137. Coal Hod Pattern

Having all the necessary measurements with which to develop the pattern, draw any horizontal line, as 8 8′ in Fig. 137, equal to 8 8^v in plan in Fig. 136. With radii equal to 8 1° in H and 8 and 8′, Fig. 137, as centers, describe arcs intersecting each other at 1. With 8‴ 7‴ in P, Fig. 136, as radius and 8 in Fig. 137 as center, describe the arc 7, which intersect by an arc struck from 1 as center and 1^x 7 in J, Fig. 136, as radius. Then with 1 2 in plan as radius and 1 in Fig. 137 as center, describe the arc 2, which intersect by an arc struck from 7 as center and 7 2° in H, Fig. 136, as radius. Proceed in this manner, using alternately, first the divisions on 8‴ 5‴ in P, and then the lengths of the slant lines in J, the divisions on 1 4 in plan and then the lengths of the slant lines in H, until the line 4 5 in Fig. 137 is obtained, which should be equal in length to 5 d''' in

the pattern for the back shown in Fig. 136. Draw a line through the points thus obtained in Fig. 137, as shown by 1 4 5 8. Trace this opposite the line 1 8′, as shown by 1 4′ 5′ 8′. Then will 4 1 4′ 5′ 8′ 8 5 be the pattern for the front and sides of the coal hod.

To all patterns laps must be allowed for wiring and seaming.

PATTERNS FOR OBLONG WASH BOILER WITH ROUNDED CORNERS

In Fig. 138 is shown a perspective view of an oblong wash boiler with rounded corners. How to develop the cover for this one piece with a seam along A will be shown. First draw the plan of the boiler, as shown by E G F H in Fig. 139, the rounded corners being struck from the centers *a a a a*. As the four quarters of the cover are alike, it will only be necessary to obtain the pattern for one quarter and there join the various parts together, as shown in the pattern Y.

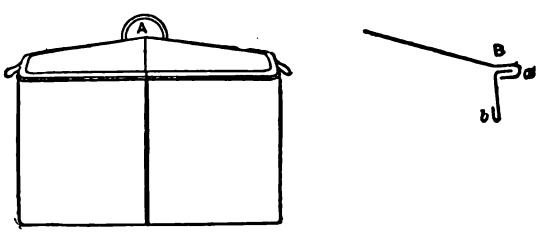


Fig. 138. Perspective View of Article

Bisect the side G in plan and obtain the point 1; also bisect the end F in plan and obtain the point 6. Now divide the quarter circle 2 5 in plan into any desired number of parts, as shown by 3 and 4. From the numbers 1 to 6 draw lines to the center J. Take the various distances J 1, J 2, J 3, J 4, J 5 and J 6, and place them on the line D C in

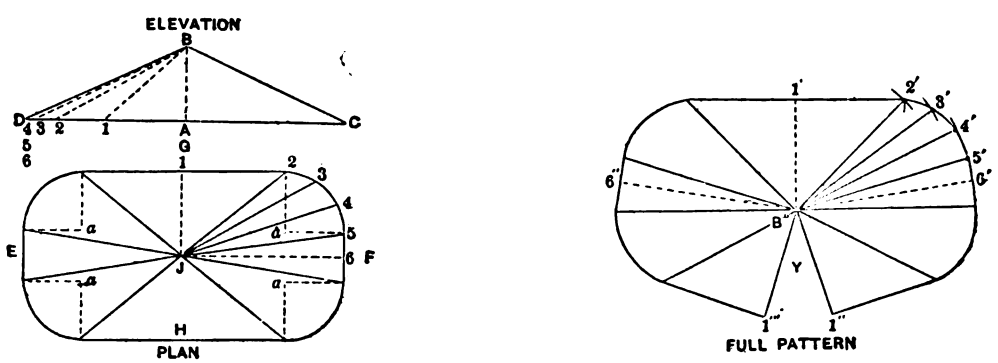


Fig. 139. Developing the Patterns

elevation, measuring from the point A, and obtain the points 1 2 3 4 5 6, from which draw lines to the apex B. These lines represent the true lengths with which to describe the pattern.

Draw any vertical line in Y, as B° 1′, equal to B 1 in elevation. With radius equal to B 2, and B° in Y as center, draw the arc 2′, which intersect by an arc struck from 1′ as center and 1 2 in plan as radius. With radii equal to B 3, 4 5 6 in elevation, and B° in Y as center, draw the arcs as shown.

Set the dividers equal to the various spaces between 2 and 6 in plan, and starting from 2′ in the pattern Y, step to arc 3′, 4′, 5′ and 6′ and draw a line from 6′ to B° and trace a line from 2′ to 6′. B°, 1′, 6′, B°, is then the quarter pattern, shown in plan by G J F. Join the four quarter patterns in Y, as shown by 1′, 6″, B°, 6″, B°, 1‴ and B°, 1″, 6′, which completes the full pattern. Laps and edges should be allowed for seaming to the rim, as shown in B in Fig. 138 by *a* and *b*.

PATTERN FOR WASH BOILER COVERS

A wash boiler with a flat bottom, such as is shown in Fig. 140, is an article often made of IX tin with copper bottom, and sometimes entirely of 16 or 18-ounce cold rolled copper. Knowing the size of the boiler, a plan of the same is drawn, as shown in Fig. 141, in which A C is the length and B D the width, the semicircular ends being struck from the centers *a* and *b*. Edges allowed to this plan, for double seaming, will give the pattern for the bottom. The pattern for the body is usually made of such hight as to avoid any waste in the metal, after the edges and wire have been allowed for, the length being obtained by taking a stretchout around the plan.

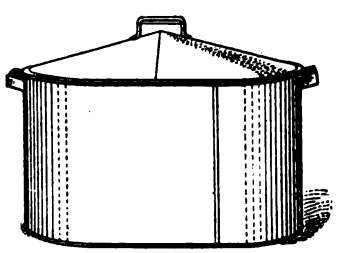


Fig. 140. Perspective View of Finished Boiler

The part to which special attention must here be given is the pitched cover, which is developed on the principles of developing a scalene cone. As both halves of the cover are symmetrical, only one-half of the pattern will be developed. Through the center *a* in plan, at right angles to *a b*, draw the diameter 1 1, as shown. Directly above the plan draw an elevation of the cover, giving the required rise J F, as shown, and draw the lines F E and F G. Divide the semicircle 1 A 1 in plan into an equal number of parts, as shown by the small figures 1 to 3 to 1, and from these points draw lines to the apex F^1.

F E in elevation represents the true length on the line F^1 A in plan, and before the pattern can be obtained, a diagram of triangles must be constructed, giving the true lengths on each of the other radial lines in plan, which are obtained as

follows: With F^1 as center and with radii equal to F^1 1, F^1 2 and F^1 D, draw arcs intersecting the center line A *b* in plan at 2′, 1′ and D^1 respectively. From these points, at right angles to A *b*, draw lines intersecting the base line E G in elevation at 3″, 2″, 1″ and D^2, from which points draw lines

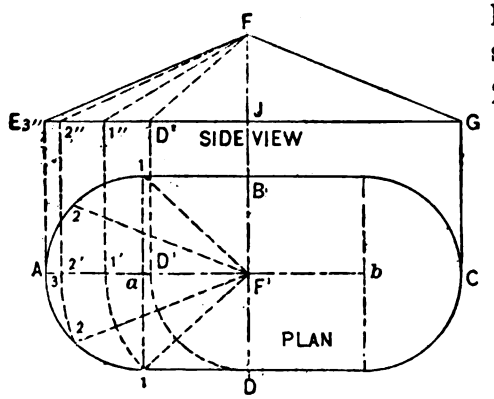


Fig. 141. Plan, Side View of Cover and Diagram of Triangles

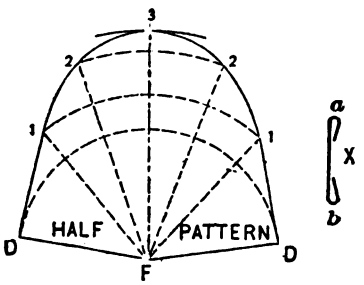


Fig. 142. Half Pattern of Cover

to the apex F. Then will these lines represent the true distances on similarly numbered lines in plan.

With radii equal to F 3″, F 2″, F 1″ and F D^2, and with F in Fig. 142 as center, describe the arcs 3, 2 2, 1 1 and D D. From the center F draw the

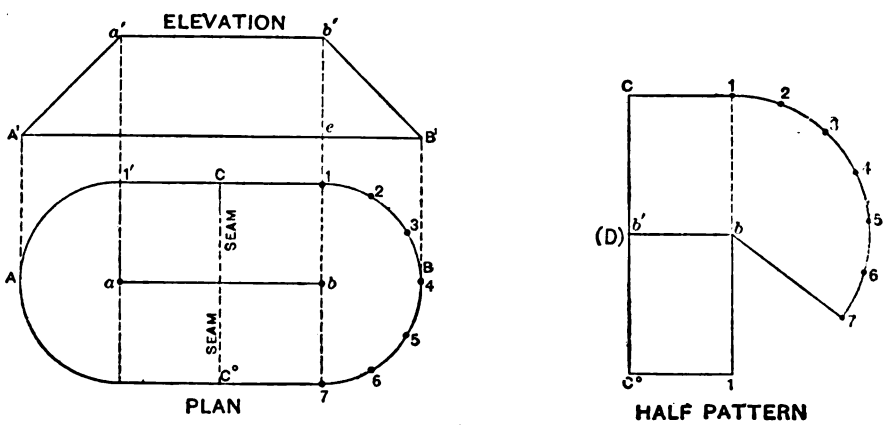


Fig. 143. Cover with Constant Flare All Around

vertical line F 3, intersecting the arc 3 at 3. Now set the dividers equal to the distances 3 to 2, 2 to 1 and 1 to D in plan in Fig. 141, and, starting from the point 3 in Fig. 142, step from one arc to another having similar numbers, thus obtaining, respectively, the points 3, 2, 1, D on both sides. Trace a line through the points thus obtained, as shown by F D 3 D F, which will be the half pattern for the cover, to which laps must be allowed for seaming. The handles shown on the boiler and cover in Fig. 140 are made with hem edges *a* and *b* in diagram X in Fig. 142. They are then riveted to the boiler and cover and soaked with solder.

In Fig. 143 is shown how to develop the pattern for a cover in two pieces, when the flare is equal all around, or, in other words, when a ridge forms in the center, as shown in plan and elevation by a b and a' b', respectively. First draw the plan of the cover, as shown by A B, the semicircular ends being struck from a and b, as centers.

Above the plan draw the elevation a' b' B^1 A^1, making the hight e b' as desired. As the cover is to be made in two parts, a seam will take place at C C° in

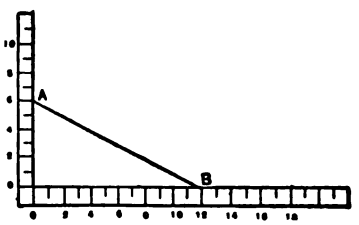


Fig. 144. Obtaining Radius from Steel Square

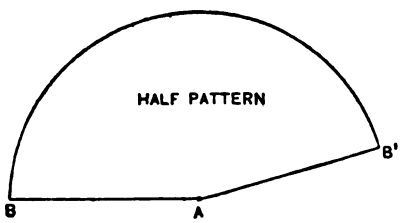


Fig. 145. One-Half Pattern

plan, as shown. Having properly drawn the plan and elevation and divided one of the semicircular ends into equal parts, shown from 1 to 7, the half pattern is obtained as shown in diagram (D), in which draw any horizontal line, C 1, equal to C 1 in plan. At right angles to C 1 in (D), from C and 1, draw C b' and 1 b equal in length to the flare b' B^1 in elevation. Now reproduce 1 C b' b opposite b b'. Using b as center, draw the arc 1 7, upon which place the girth of the semicircle in plan. Draw a radial line from 7 to b, which completes the half pattern.

In the following is shown a short rule for obtaining the pattern for round pitched covers of any diameter or hight. Supposing a pitched cover is desired, 24 inches in diameter and 6 inches high, and the pattern is to be laid off directly onto the metal without the use of any drawing. Then proceed as is shown in Fig. 144, which gives a diagram of a steel square with the various dimensions on same. Place one point of the compass on 6 on one arm of the square, which represents the hight, and the other point on 12, representing the half diameter; then will this distance, A B, be the radius with which to strike the pattern. Now with any point, as A in Fig. 145, as center, describe the arc B B^1. Multiply the diameter 24 by 3 1-7, which will equal 75 3-7 inches, the circumference of the 24-inch circle. Divide by 2 for the half pattern, which leaves 37 5-7 inches. Set the dividers 1 inch distant, and step off 37 1-inch spaces on the arc B B^1, starting from B. Divide the inch division on the rule into seven equal spaces and add five of these spaces on the arc B B^1. Draw a line from A to B and A to B^1, which will complete the one-half pattern for the cover.

GROCER'S OVAL FUNNEL

In Fig. 146 is shown a perspective view of an oval funnel, with a handle at *a*. Its construction is indicated in Fig. 147, in which *a a*, *c c* is oval in shape, having a wired edge at *a a*. And *d d*, *b b* is a round collar wired at *b b*. The funnel proper is a transition piece from oval to round, with edges at *c c* and *d d*.

The patterns for the top and bottom collars are straight strips of the required width and equal to the circumferences of the oval and round sections, respectively.

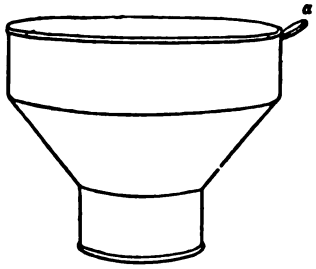


Fig. 146. General View

The pattern for the funnel is developed by triangulation, as shown in Fig. 148, in which A B C D is the plan of the oval top and E the plan of the round collar. As the four quarters are symmetrical, it is only necessary in practice to draw one quarter plan, as, for example, B.

Divide both the inner and outer curve into equal parts, as shown from 1 to 7 and 2 to 8, which connect, as shown. These lines then represent the base lines of triangles, the altitudes of which will equal the hight of the funnel. This hight is shown by 2 2′, the elevation of the funnel not being required. Take the girth of 1 2 3 4 5 6 7 8 and place it on any horizontal line, as shown from 1 to 8 in the diagram of triangles. As the points 2. 4, 6 and 8 in the plan represent the highest points,

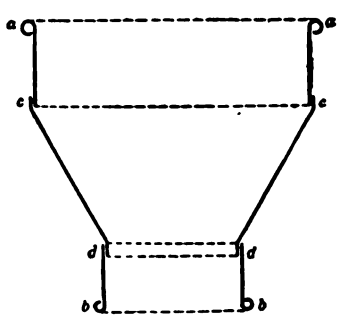


Fig. 147

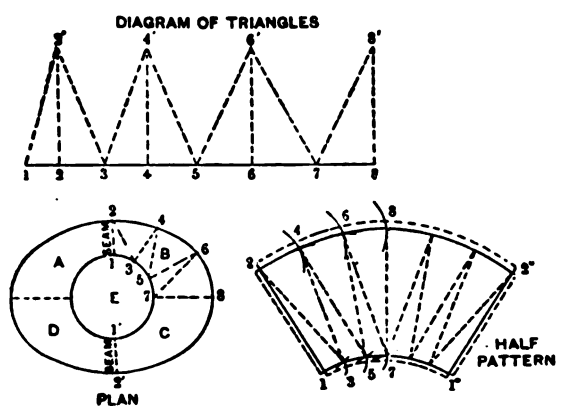


Fig. 148

Section and Method of Obtaining the Pattern

then from 2, 4, 6, and 8 erect vertical lines equal to the hight of the funnel, as shown by 2 2′, 4 4′, 6 6′, and 8 8′, and connect slant lines, as shown. The latter represent the true lengths of similar numbered lines in the plan. Thus, 3 4′ shows the true length of 3 4 in plan, etc.

The quarter pattern is obtained as follows: Take the distance of 1 2′ and place it on any line, as 1 2 in the pattern. With 1 as center, describe the arc 3,

with radius equal to 1 3 in plan. Now, with radius equal to 1′ 3, and 2 in the pattern as center, describe the arc 3, intersecting the one previously drawn at 3.

With radius equal to 2 4 in plan, and 2 in the pattern as center, describe an arc, which intersect by an arc struck from 3 as center, and 3 4′ in the triangles as radius. Proceed in this manner, using alternately as radii, first the spaces in the circle E, then the true length in the triangles, the spaces in the oval B and the proper slant lines in the diagram of triangles, until the line 7 8 in the pattern is obtained.

A line traced through points thus obtained, as shown by 2 8 7 1, is the one-quarter pattern. If the funnel is to be made in two parts, transfer 2 8 7 1 opposite the line 8 7, as shown by 8 2° 1° 7. Then 1 1°, 2° 2 will be the half-pattern, to which edges are allowed for soldering and seaming.

REVOLVING BENCH FOR TINNERS' MACHINES

A handy arrangement for the turning and similar machines used by the tinsmith is a revolving bench, so that the different machines can be used in series as they are required, as shown by Fig. 149. By revolving the bench, the machine needed next can be brought convenient to the workman and is made as follows:

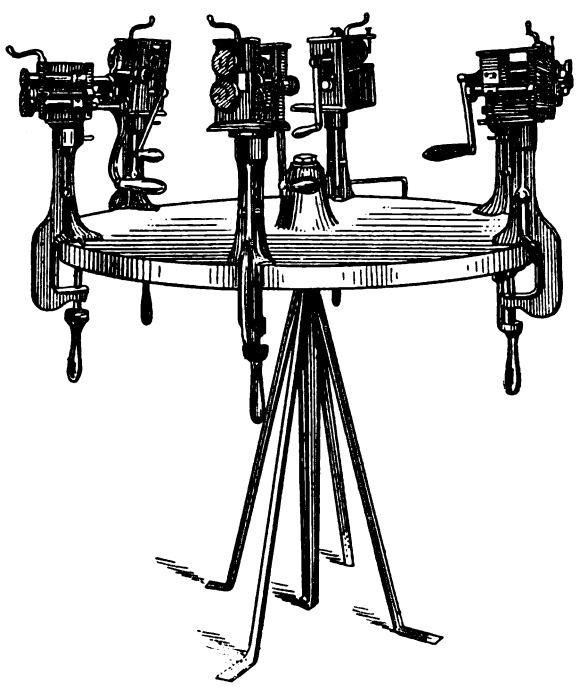


Fig. 149. Revolving Bench for Tinners' Machines

One of the wheels and part of the axle from an old wagon were purchased for a small sum and the axle was cut off, so that one end was securely fastened in the floor. It brought the top of the wheel at the right hight from the floor for a bench for the machines. Two holes were drilled through the axle below the hub of the wheel and at right angles to each other. These holes were for the bolts used for securing the top end of the braces shown in the picture, which were securely fastened by the bolts and nuts. These braces were made of ¾-in. pipe, the ends being flattened after being heated in the tinners' furnace, and the ends were also bent to the right angle to fit against the axle and on

the floor. Two holes were drilled in the bottom ends for fastening to the floor by means of wood screws. The braces held the axle in a vertical position and firmly.

The wheel was then placed on the axle, and it was a simple matter for the sheet metal worker to make a covering of sheet metal to lay on the spokes to prevent articles from dropping through and to afford a support for the work. The nut on the end of the axle is screwed down on the top of the hub tight enough to prevent the wheel from moving unless some energy is expended. By this means the machines attached to the rim of the wheel are held with sufficient steadiness for all ordinary work and yet the wheel can be turned to bring the different machines in position as they are required for work. It would be a good idea to make tin covers to slip over the machines to exclude dust when machines are not in use.

SQUARING TIN

The usual method of squaring tin by means of the squaring shears is to set the gauge for the width of the sheet, then by laying one edge of the sheet over the gauge, cut one edge. The sheet is then turned over and the cut edge brought against the gauge, when the remaining edge is cut. This operation is continued until the desired number of sheets have had their sides trimmed.

The front gauge is then moved back, say 19¾ inches from the blade. A sheet is then brought against the side gauge and one end allowed to project over the front gauge, when the end is cut. The sheet is then turned over and the cut edge brought against the front gauge, when the remaining end is cut. This double operation consumes unnecessary time, as each sheet must be handled twice, and in case it is desired to commence work with some of the tin at once, it is necessary to either wait until the tin has all been cut one way before it can be finished, or the gauge must be changed so a limited number of sheets can be finished.

In some shops the "square sheet" is used for a pattern for setting the gauge, but it sometimes happens that in trying to see if the shears are properly set a narrow strip is cut off the pattern, thus reducing its size. When setting the shears by means of the square, there is danger of injuring the cutting edges of the shear blades.

All of these difficulties can be overcome by means of simple arrangements, one of which is shown in Fig. 150. Let G H represent the shear bed, E the cutting knife and A B one of the arms. A piece of heavy sheet iron of sufficient length is placed as indicated by C D. From D to E is to be the width the sheet is to be cut. An iron gauge, C F is riveted to the iron, so the distance F E will

be the length of the sheet, say 19¾ inches. Below the end elevation the sheet iron is represented by J K, and the gauge by M. Two or more pieces of bent iron are riveted under the sheet iron, as shown at L, so as to be brought against the shear bed and thus insure the proper position of the attachment. In the plan, only

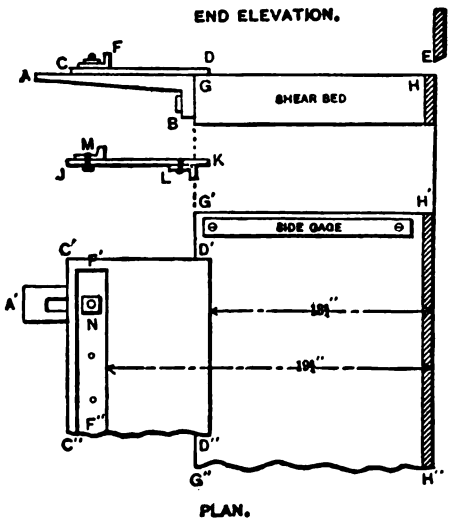


Fig. 150. Sheet Iron Gauge

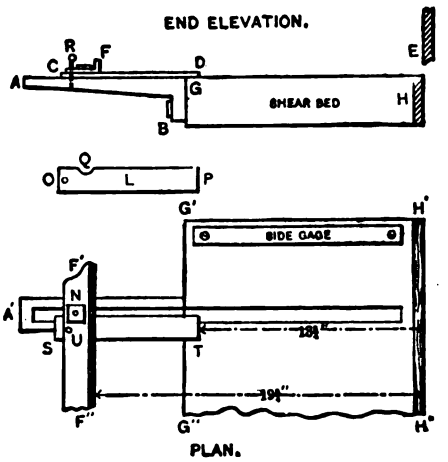


Fig. 151. Band Iron Gauge

part of the shear bed is shown, and is represented by G′ H′ H″ G″. The sheet iron is represented by C′ D′ D″ C″, and the iron gauge by F′ F″. This gauge can be made from a bar of iron having one side and edge planed true. The device can be secured to the arm A′ by a bolt at N, by slipping the edge C′ C″ under the regular gauge and screwing tight, or by any convenient means. The reader will understand that as only part of the shear bed is shown in plan, the other arm, similar to A′ is not represented.

When tin is to be squared the gauge is placed in position and secured. A sheet of tin is laid with one side between the shear blades and the other over D and the edge cut. The sheet is then turned over bringing the cut edge against D, when the side is cut. One side of the sheet is brought against the side gauge (shown in plan) and the end cut. The sheet is then turned over, bringing the cut end against F, when the remaining edge is cut. Thus the sheet is squared without laying down. If special sizes of tin are needed in quantities, as the gores for square pipe, other gauges can be made as required.

Another form of gauge, operated as above described, which can be made from two pieces of one inch band iron—such as usually comes about galvanized iron—is shown in Fig. 151. The regular sliding gauge F is used. Two pieces of band iron about 8 inches long are to be prepared, as shown by O P. The notch Q is cut

out so the iron will pass by the bolt that holds the sliding gauge in position. The ends of the band iron, as at P, are to be filed square. The pieces are to be slipped under the gauge, as shown by C D in elevation or S T in plan. The distance between ends D to shear blade E is to be equal to the width the sheet is to be cut. The sliding gauge is to be so set that the distance F E of elevation or F′ F″ to H′ H″ of plan will be equal to the length the sheet is to be cut. After the strips and sliding gauge are found to be exactly in the proper position the nuts are to be screwed up tight, and, by means of a twist drill, small holes are to be drilled through the sliding gauge, band iron and arm of shears at each of the arms. Through each hole a slightly tapering pin is passed, as indicated at R in elevation. The hole is also shown at U in plan. After the holes are drilled, if it should be found that the band iron strips are not of the exact length required, they can be lengthened by hammering on a stake, or shortened by filing. It will be found convenient to mark the strips R and L, to designate which goes to the right or left hand arm of the shears. The iron pins can be attached to the shears by means of string or chain. To set the shears for squaring tin it is only necessary to place the strips in position on the arms, and under the sliding gauge, put the two pins through the holes in gauge, strips and arms, and screw up the two bolts. By this arrangement the tin should always be of a size, which is a great convenience. Before drilling the holes it may be well to cut the sides of a sheet, then reverse its position on the shears, to determine if the sliding gauge is exactly in position.

A HOME MADE WIRE CUTTER AND REEL

This cutter, illustrated by Fig. 152, has numerous advantages, the most important feature being fast cutting, the jaws always being open and in such a position as to enable the operator to use both hands for controlling the wire, so he can cut as fast as the foot can work the treadle. A lively boy can cut from 75 to 100 gross of two-quart bucket bails in a day. The machine will cut any size of wire up to No. 6 with ease. If heavier wire is to be cut, larger shears should be used for the machine. It will be seen from an inspection of the engraving, that the cutter is a very cheap one to construct, for the reason that in most any tin shop that has been in business a number of years can be found a pair of old stock shears that can be used for the purpose. Any country blacksmith can do the iron work.

To construct the wire cutter: Fasten a piece of 2×12 plank, as shown at A, to the end of an ordinary work bench, and secure firmly to the end of bench

and floor. Take an old pair of stock shears and cut the blades off, leaving them about 2 inches long. Care must be taken, if they are heated before cutting, that the temper is not injured. The safest way is to cut through the iron while cold, then place in the vice and strike on the steel side with a heavy hammer, thus breaking off the ends. The rough edges can be ground on an emery wheel. Next cut the handles off, leaving the one to be attached to the lever 6 inches longer than the other. Put a ½-inch steel pin in the longer handle, letting it project 1½ inches, as shown at E. The shears B are to be fastened to the plank A by two ½-inch bolts, through holes in handle at C and D. Take a piece of ½×1¼-inch iron 26 inches long and bend off 6 inches at right angles, as shown. Then cut a slot at F in end 9-16×1½ inches to receive the steel pin E. Flatten out the other end, as shown at I, for a foot piece. Drill a hole at G for a ¾-inch bolt, which secures treadle to plank A. The guard H is made from a piece of ¼×1-inch iron, bent as shown, and secured to the plank A by means of screws or bolts at M and N. J is a spring made of No. 8 spring wire, and when finished should be 9 inches long and 1½ inches in diameter. It is secured to plank by a screw at O, the other end being turned over so as to pass through the opening in treadle at P. The wire holder K can be made of 1½×1½ angle iron, and bent to the required curve while hot, or it can be made of cast iron. The length of holder K will depend upon length of wire to be cut. The gauge L, which slides on the holder K, is provided with a set screw for securing it in any desired position.

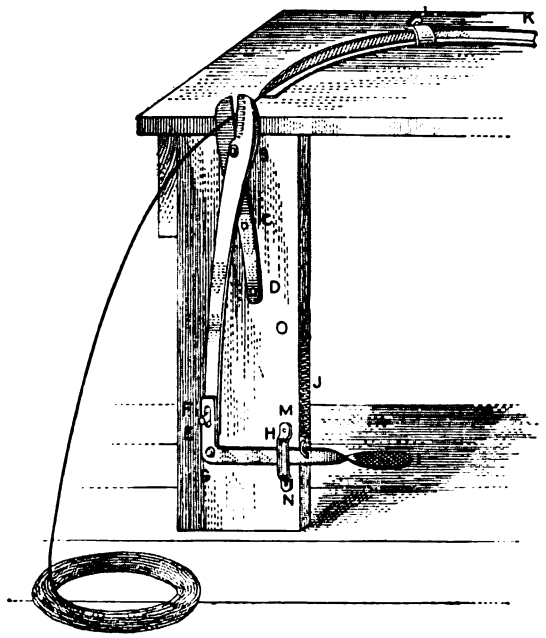


Fig. 152. General View of the Cutter

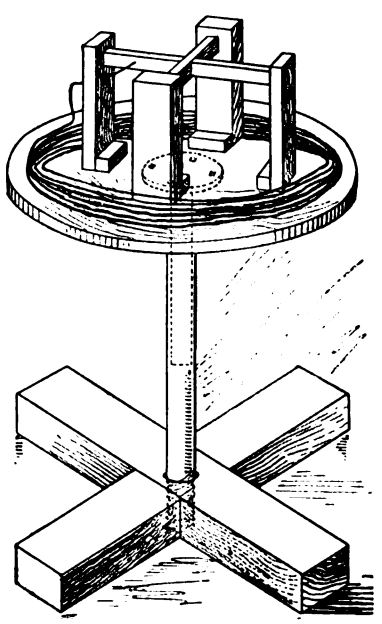


Fig. 153. General View of the Reel

Any tinsmith does enough work on buildings where carpenters are working, to get a couple of pieces of wood 3×4 in. that are

about 1½ ft. long, so that he can mortise them together to form a cross like that shown in Fig. 153, and then bore a hole 2 in. in diameter, or large enough for a piece of 1½-in. pipe to be firmly screwed down into these cross pieces, so that it will stand upright. On top of the pipe the reel for the wire will rest. It is made by screwing the flange for a 1-in. pipe, or whatever size will go down in the upstanding pipe. This flange should be drilled so that it can be secured to the board bottom of the reel. The reel proper is made by nailing four or more wood uprights about 3 in. wide, to the bottom of the reel. To prevent them from being drawn in at the top or pulled from the nails at the bottom, a staypiece should run across from one upright to the other. Holes are drilled at various places in the uprights, in which the loose end of the wire is inserted, when no wire is being cut. If a suitable hinge arrangement is made on the upright support, the wire can be uncoiled in both the horizontal plane it is in, as Fig. 153, or in a vertical plane.

A DEVICE FOR SOLDERING FURNACE PIPE

By having just the right apparatus for doing different kinds of jobs in a tin shop, a great deal of time can be saved. The following apparatus, shown in Fig. 154, for soldering furnace pipe, has been a great convenience. It consists of two tapering cylinders made of galvanized iron. The cylinders should be about 10 inches long, 15 inches in diameter at one end and 6 inches at the other, and should be provided with a bearing for the axle of the cylinder to work on. This bearing should be made of galvanized iron and securely soldered at each end. The diameter

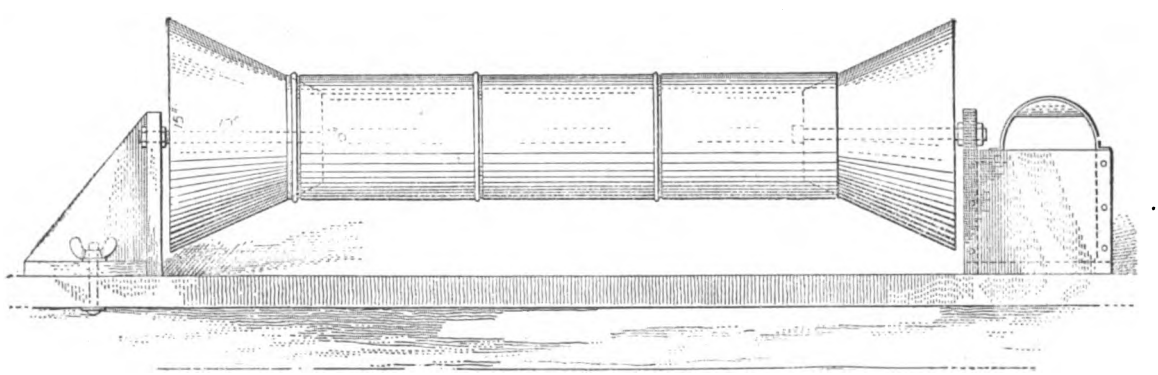


Fig. 154. Device for Soldering Furnace Pipe

should be sufficient to allow a ¼-inch gas pipe to work in it freely. One of the cylinders is attached to a support made of inch boards 6 inches wide, and the bottom part 6 inches long and an upright 12 inches high. The upright should be braced

to the bottom board by means of another piece of board cut triangular in shape, and nailed to the edge of the two boards, holding them at right angles to each other. The hole should be bored in the upright 10 inches from the bottom, and a piece of ¼-inch gas pipe 13 inches long should be provided, with a long thread on one end and a short thread on the other. The lock nut should be placed on the ¼-inch pipe on both sides of the board to hold it firmly in place. Then the cylinder should be slipped on and a cap put on the outer end of the pipe. The other cylinder is attached to an inch board upright in the same way, and to this upright should be fastened a galvanized iron box 10 inches long, 6 inches wide and 8 inches deep. After the box is filled with old castings, or any material to make it heavy, the hoop should be put on and provided with a handle. This permits the cylinder to be readily movable. The first cylinder should be secured to the bench by means of a thumb screw. After several sections of tin pipe have been slipped together, one end should be slipped over the stationary cylinder, and the movable cylinder should be brought up into the other end of the pipe. The workman can now tack the seams on one side, and then the pipe will readily revolve until the bottom side is up, when a careful alignment of the pipe can be made and this side tacked with solder to hold the pipe in position. The pipe can be revolved while it is being soldered, and the work be done with ease and dispatch. After all the different seams are soldered, the movable cylinder is readily withdrawn and the pipe can be removed without any loss of time.

ANOTHER DEVICE FOR SOLDERING FURNACE PIPES

In soldering furnace pipe it has been found that this device is of great convenience, as well as a time and labor saver. As shown in Fig. 155 an ordinary tressel made of a piece of 4×6 timber with four legs serves as a base, and as the upper part need not be fastened to it the tressel can be used for other things. To a board an inch thick, 10 inches wide and 4 feet long, nail two strips long enough to go between the legs on the side of the tressel. They should be nailed edgewise and so that the center of the board would come over the center of the tressel. They should be as wide as the tressel is thick, about 4 inches, and 1 inch thick. This will enable the board to rest firmly on the tressel, and it can be lifted off or on with ease. Now get four wooden wheels 6 inches in diameter and 1 inch thick and bore a hole in the center for a ¼-inch stove bolt. If you prefer you can make these wheels of tin. Bend eight pieces of the band iron that comes around bundles of sheet iron at a right angle. Make one end long enough to take two ¾ No. 9 wood screws to hold it to the board. The other end should

have a hole in it for a ¼-inch stove bolt, which serves as an axle for the wooden wheels. This end should be long enough to bring the tops of the wheels about 3 feet from the ground. These uprights should be screwed fast to the board 6 inches from the end and 3½ inches from the center and 1⅛ inches apart, to give the wheels room to turn. Then put the wheels in place and fasten them with the ¼-inch stove bolts through the holes in the upright. Tack three sections of 14-inch pipe on the bench and then lay them on the wheels and with some rosin run around the seam. Then with a hot copper and a bar of solder a seam can be soldered without any stops and starts, evenly all around, almost as quick as the rosin is put on. It beats a trough for quick, easy work, and consequently saves considerable rosin and solder.

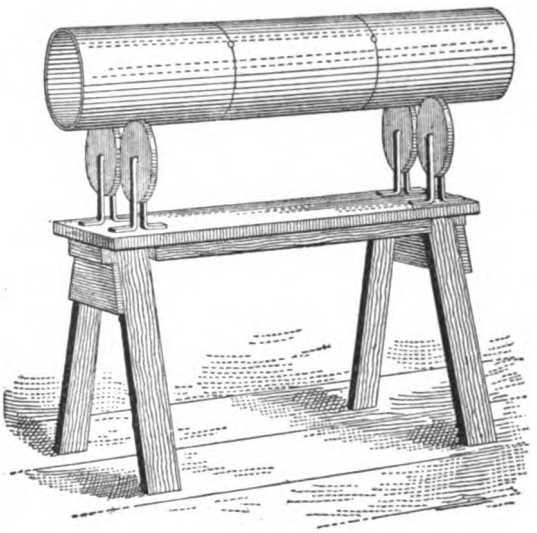


Fig. 155. A Scheme for Soldering Furnace Pipe.

SWEDGING LARGE FURNACE BODIES

With the device illustrated by Fig. 156, bodies or furnace casing of from 40 to 60 inches in diameter can be readily swedged by one man. This device is arranged to bring the point between the rolls 52 inches above the floor, and this is done by setting one end of an oak plank 2 inches thick, 8 inches wide and 4 feet long, on a base made of strong boards, as shown in Fig. 156. The base should be as wide as the plank and about 18 inches long, and should set on the work bench and be fastened to it at the back end by two bolts long enough to go through both, and having wing nuts. A hole should be cut in the plank for the swedging machine stand. The hight of the base must be sufficient to make the 52 inches when added to the hight of the work bench and the machine, and if braces are put on each side of the base, it will be stiffer. At the outer end of the plank place a piece of inch board 1 foot long and 4 inches wide, supported by two tapering uprights. On each end of the 4-inch strips put a universal caster. The hights of the supports should bring the top of the casters level with the point where the rolls meet, and they should be on a line with the roll shaft. On each side of the top strip, hinge a piece of board 12 inches wide and 15 inches long, and put a universal

caster on each of the outer end corners. To each of the hinged boards fasten a piece of iron 3-16×1 inch and 15 inches long, by means of a round head screw

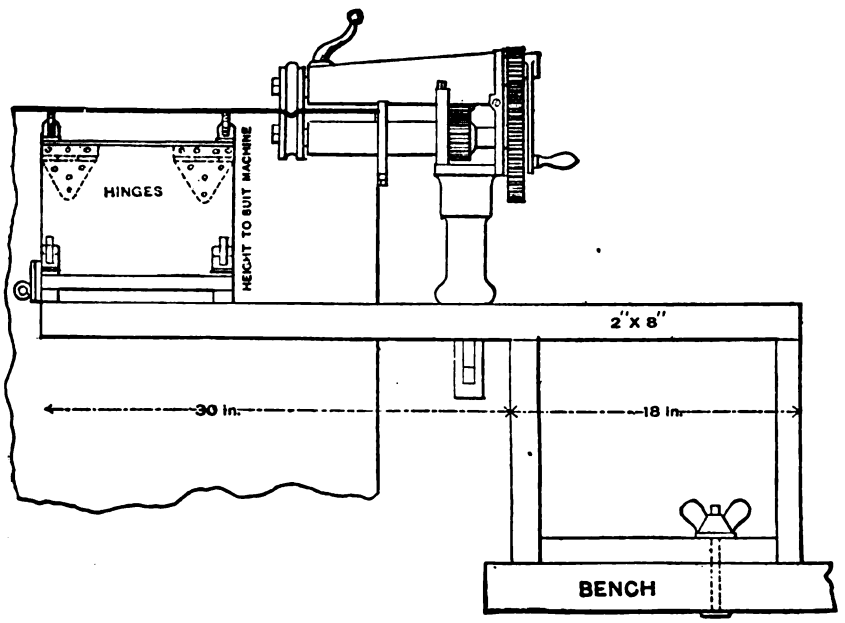


Fig. 156. Showing Side View of Apparatus

through a hole in the iron. To let one iron work smoothly on top of the other, a piece of the iron 1 inch square with a hole in it should be put under one of the irons, where it is fastened to the hinged board. In the other end of the iron, drill ¼-inch holes ¾ inch apart for half its length. Put a ¼-inch hole in the front upright near the bottom, and have a ¼-inch pin 4 inches long with an eye at one end, so that it can be fastened by a cord to the upright. By placing the pin in the holes in the iron and upright, the hinged board can be supported at any hight to make the casters carry heater bodies of different diameters, as in Fig. 157.

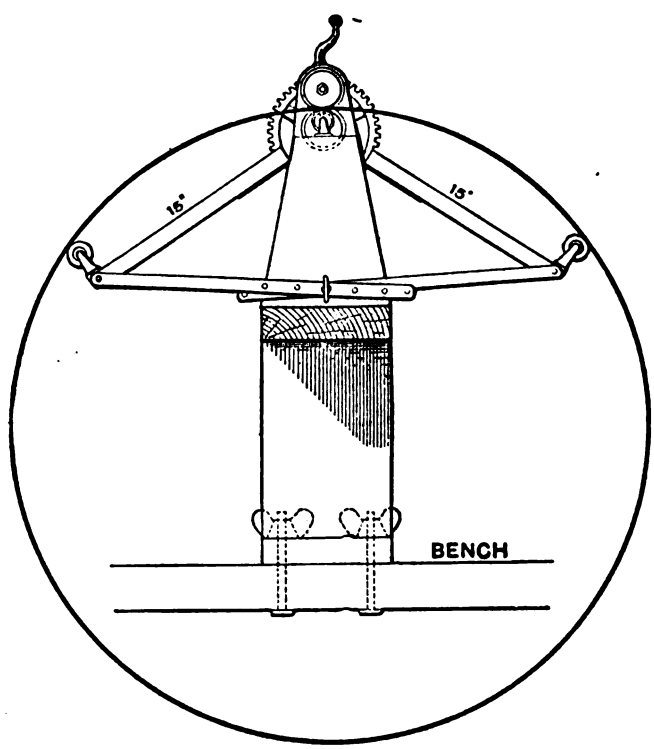


Fig. 157. Showing End View

SHORT RULE FOR CHIMNEY BASE

In Fig. 158 is shown a perspective view of a smoke stack base, in which A is the base, B the flange, which rests on the chimney and is cemented, and C the collar, which fits into the chimney D. When making up the complete base, it is constructed as indicated in Fig. 159, in which the base A has a ½-in. flange at *a*, which is riveted to the collar and the flange B at *b*. It will be noted that the collar and flange are doubled at *c* with a hem edge at *d*. The short rule for obtaining the pattern for the base is shown in Fig. 160, and can be used for any size chimney or pipe. While a full plan is shown, a one-quarter plan is all that is required.

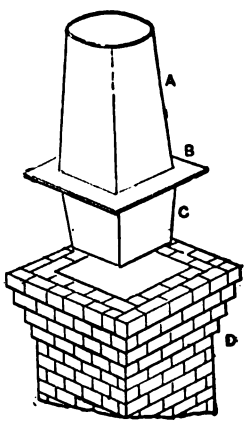


Fig. 158
View of Smokestack Base

Let A B C D show the size of the opening in the chimney and E H the size of the smoke pipe. Draw the two diagonals A C and B D intersecting each other at E, the center point from which the circle is struck, and which intersects the diagonal at H. From H at right angles to E B draw the line H J equal to the hight of the base. Also from E draw the perpendicular E F indefinitely. Draw a line from B through J until it meets the center line at F.

With radii equal to F J and F B and with F^1 as center, draw the arcs L M and D^1 D^2. Starting from D^1 step off on the arc drawn divisions equal to D A, A B, B C and C D in plan, as shown by similar letters in the pattern, from which points connect lines as shown, and add the lap indicated by the dotted line. Take one-half the girth of the circle H in plan and place it on either side of the pattern, as shown from J^1 to M and from J^1 to L. Draw lines from D^1 to M and from D^2 to L. Allow a lap for riveting as shown by M D^1.

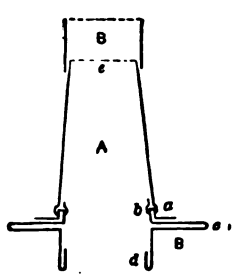
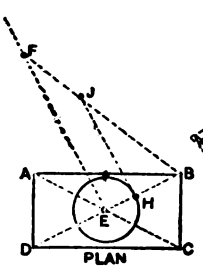


Fig. 159. Construction Indicated



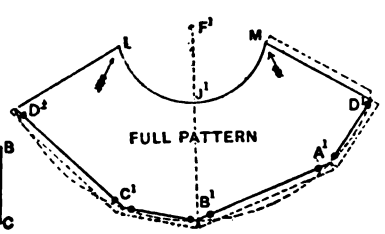


Fig. 160. Pattern for the Base

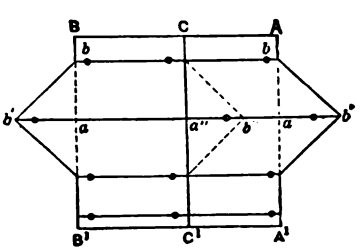


Fig. 161. Pattern for Flange

This results in an accurate pattern, with the exception that the lines D^2 L and D^1 M are not true radial lines, and give an acute angle shown by the arrow points L and M. This will in no way interfere with the pattern nor require any trimming,

because the upper joint of smoke pipe will cover it when lapping as is shown in Fig. 159, when B overlaps A at *e*.

The patterns for the flange and collar combined are shown in Fig. 161. Obtain the girth of *b c d* in Fig. 159 and place it on any vertical line in Fig. 161, through which draw the usual measuring lines, as shown. Take the distances of A B and B C in plan in Fig. 160 and place them, as shown, by A B and B C in Fig. 161. Draw vertical lines A A^1, B B^1 and C C^1. Take the distance from *a* to *b* and place it, as shown, from *a* to *b'* on both sides, and from *a''* to *b''*. Connect lines, as shown, A B B^1 A^1 and B C C^1 B^1 are then the patterns for the long and short sides of the flange, to fit into the base, as indicated in Fig. 159.

Sometimes instead of using a flange, the entire chimney is covered the same as an inverted pan. The method here shown gives the best results, though of course, considerable cementing is necessary to make a tight joint with the chimney.

SHORT RULE FOR DRUM ELBOW

In Fig. 162 is shown a view of a finished drum elbow. Fig. 163 shows how to lay out the patterns without using an elevation. First, draw the plan of the elliptical drum shown by A, through which draw the long and short diameters, as shown. Extend the short diameter, as A C, and, using C as center, describe the section of the round pipe. This is shown in plan by B.

To obtain the pattern for this pipe divide C into equal spaces, as shown from 1 to 5 to 1, from which draw horizontal lines intersecting the ellipse A at 1′ to 5′. Extend the line of the round pipe, as D E, and, assuming that the seam is to come at the bottom, lay off on D E in Fig. 163, the stretchout shown from 3 to 3 in C. Through these points, at right angles to D E, draw lines, which intersect by lines drawn from 3′ to 5′ in A parallel to D E. Trace the curved line G F. Then will G F 3 3 be the half pattern for the round pipe.

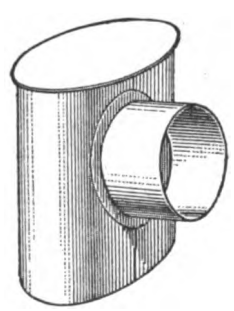


Fig. 162. The Drum Elbow

For the half pattern for the drum and opening establish the points *b* and *c* in A, and take the stretchout of *a*, *b*, 1′ to 5′, *c*, *d*, and place it on a vertical line, as H I. From the numbers draw horizontal lines, which intersect by vertical lines drawn from similar points in the section C. Trace a line through points thus obtained; then will the shaded part N be the shape of the opening to be cut.

Knowing the hight of A in Fig. 163 and the distance that the round pipe is to set below the top, set off these spaces above and below the opening N in Fig. 163, and draw vertical lines through the points obtained, which limit by horizontal lines drawn from *a* and *d* in the stretchout. Then will J K L M be the half pattern. When the paper pattern is developed draw a line through 3′, as *e f*, which represents the proper seam line. Then one-half the opening N should be

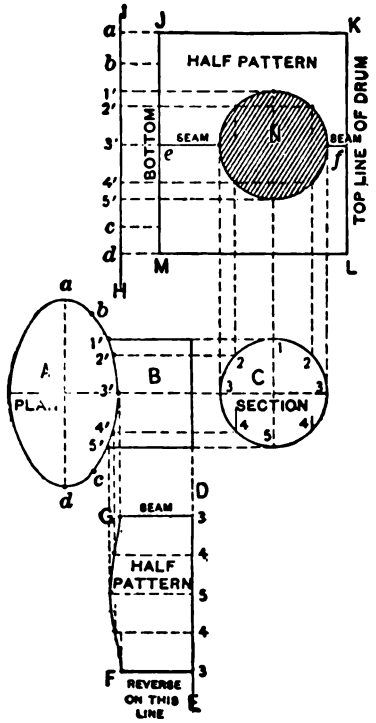


Fig. 163. The Patterns

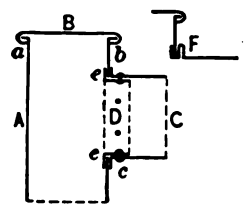


Fig. 164. Sectional View

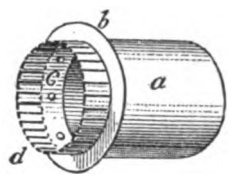


Fig. 165. Notching Collar

placed at either end of the full pattern for the drum, allowing laps for riveting or seaming. The plan A, with edge allowed, answers for the pattern for the top of the drum.

The method of constructing the drum elbow is shown in Fig. 164, where A is the drum and B the top, double seamed at *a*. C is the round pipe flanged at *b*, and D a collar, about 2 inches long, riveted to C, and the projecting ½ inch notched and turned against the drum at *e e*. By this method the body is held firmly between the two flanges *b c* and *e e*. In cutting the collar D the same miter cut is used as shown by G F in Fig. 163, but it is made slightly smaller to fit into the round pipe.

Fig. 165 shows the perspective of the round pipe *a*, with flange *b*, also the collar *c* riveted to *a* and notched at *d* ½ inch. This extra work of riveting and notching the collar can be avoided if a special machine is used, which is made to form a lock, as shown in F in Fig. 164. If this machine is not at hand, the ordinary thick edge will answer the purpose just as well. The swedge F of Fig. 164 is made as deep as possible with this machine, allowing say ⅜ of an inch edge to project past this swedge and this edge is inserted in the opening of the drum. The elbow is now stood on the collar and this edge thrown over by a heavy bar of iron giving the same appearance as at F. It is to be understood that, in both methods, the cap B of Fig. 164 is placed on last.

PATTERN FOR RANGE CANOPY

In the accompanying illustration is given the pattern for a range canopy, the perspective view in Fig. 166 showing the canopy in position and giving a general idea of its outline. In cutting the pattern let A B C D, Fig. 167, be the front elevation of the canopy and E 6 2 the side elevation. A flange is added from 2 to 1, through which the canopy is fastened to the chimney or wall. To obtain the pattern for the side extend the line 1 E in the side elevation, as shown by F G.

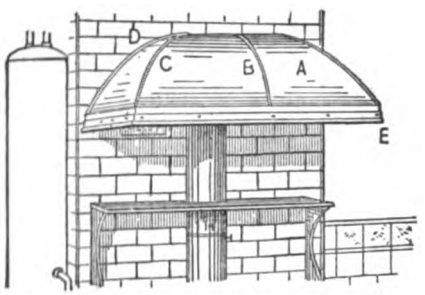


Fig. 166. Perspective View of Range Canopy

Divide the curve 2 6 in the side elevation into an equal number of parts, as shown by the small figures 1 to 6. Place a stretchout of 1 6 on the line F G, as shown from 1 to 6. Through these small figures at right angles to F G draw lines as shown, which intersect with lines drawn at right angles to 6 E from similar points in the side elevation. Trace a line through the points thus obtained, and 1 6 H will be the pattern for the side. No allowance has been made for wire which must be added to the pattern, as the pattern is only developed to the under side of the wire, as shown by 6 in the side elevation.

The pattern for the front is obtained as follows, using the miter cut on the side pattern: First draw the line J I equal in length to D C. Using the side pattern 1 H 6, place the bottom of the pattern H 6 upon the line J I, placing the corner H of the pattern upon the corner J, and mark the miter J K. Reverse the side pattern, and in precisely the same manner obtain the miter cut I L. Then will K L I J be the pattern for the front. Laps must be allowed on the front and side patterns, to allow flanges to be stretched to obtain a standing seam on the corners, as shown by C in Fig. 166, or by b' a b'' in Fig. 168. It will be noticed that at a there is a single and a double edge through which rivets are placed at intervals.

A flange must also be allowed to the straight part 1 to 6 of the side pattern in Fig. 167 to allow a flange to be stretched, so that the canopy can be fastened against the chimney D in Fig. 166. It is sometimes the case that the front of the canopy is of such length that a number of sheets are required. In that case straight sheets are placed between by means of the standing seam e a e' in Fig. 168 and shown at B in Fig. 166, riveting the same as before mentioned.

Assuming that the canopy has a wired edge, as shown by D in Fig. 168, it is fastened to the wall A by nailing through the flange C, the canopy, if very long, being balanced by means of a neat brass or galvanized chain E. Sometimes the

wire edge is omitted, and a band of iron is bolted or riveted to the lower edge, as shown at E in Fig. 166. The band iron is encased, as shown by F in Fig. 168, in which *b* shows the band or flat iron, the metal *c* from the canopy being bent

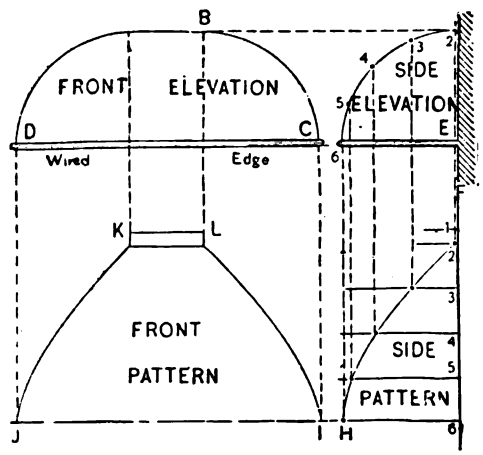


Fig. 167. Elevations and Patterns

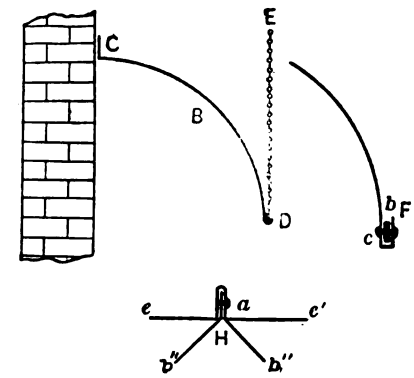


Fig. 168. Details of Construction

around the band iron, as shown, the rivet or bolt being indicated by *c*. Chains are also employed in this case to hold it in a plumb position.

In preparing the flange for the canopy seams, when both pieces to be seamed are curved in completed job, proceed as follows: After the patterns have been developed and allowance made to same for flanging, pass the flange through the

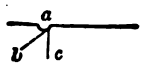
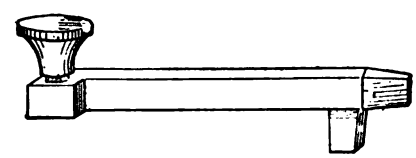


Fig. 169

Fig. 170



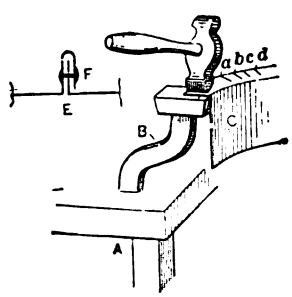


Fig. 171

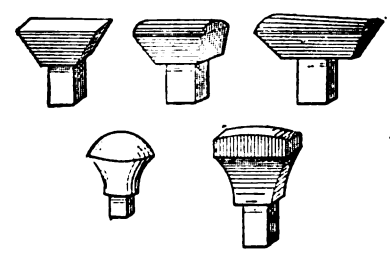


Fig. 172

The Procedure of Making Standing Seams

large turning machine, which will put a small groove along the curve of the pattern and will look as at *a* in Fig. 169. This small groove serves as a guide in stretching the flange, which is gradually turned over the stake at an angle indicated by *b*;

then to a right angle, as at *c*, holding the sheet metal to the required curve by means of a wood template secured to it.

The stretching is done by the use of a stretching hammer, shown in Fig. 170, the faces of which are 1 inch wide, one side being a little sharper than the other, and the edges on both being rounded. The method of using this hammer is shown in Fig. 171, in which A represents part of a bench, in which the square stake B is placed. C shows the article to be stretched. This is done by using the hammer D, just described, and striking along the edges of the flange, as at *a*, *b*, *c* and *d*, being careful to strike each blow with equal strength and at equal distance apart. When the desired curve has almost been reached, use a flat face hammer to flatten the flange and take out the buckles, after which dress down square with the mallet.

In seaming the two sections together one side requires more flange than the other, so as to allow the turning of the left flange over the right one, as shown at F, in E. Knowing the amount that the left flange turns over the right, set the turning machine to the required distance and obtain a small groove along the flange, which acts as a guide, then turn the double flange, which will look as shown at F, when completed. When the pieces are level on the inside, as at E, the rivets F are placed at desired distances. This method of stretching applies to all similar kinds of work.

Fig. 172 shows a double seaming stake, that can be used for this work with six heads. Any desired head can be used in the mandrel, and where the article to be seamed is of such size that the mandrel cannot be used, the heads can be used as hand stakes in large sized metal bodies.

STOVE PIPE RADIATORS OR HEATING DRUMS

Although it may be grammatically correct to speak only of those having a cylindrical form as drums, the term as now used in the sheet metal worker's vocabulary may include various shapes—oval, square, rectangular, etc.—so long as the object of the contrivance is to save heat that might otherwise pass out of the chimney. They are thus economical to the user because they allow a large per cent. of heat to be utilized in heating the house instead of the chimney. They also allow of a more thorough distribution of the heat, as in the case of a chamber through which the stove pipe must pass. In other cases a room may be heated by a hot air pipe leading from another such contrivance. The smoke pipe from a

furnace is often so hot near the chimney that the hand cannot be held upon it; in such cases a hot air drum may be used to advantage.

Plain and annealed sheet iron can now be procured in handy sizes, that the tinner will find very convenient to work up. Among the sizes made, 18×42 inches, about No. 28, will be found perhaps the most useful. Russia iron and its imitation may also be used effectively.

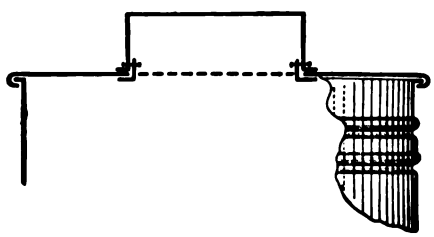


Fig. 173. Section Through Cylinder Drum

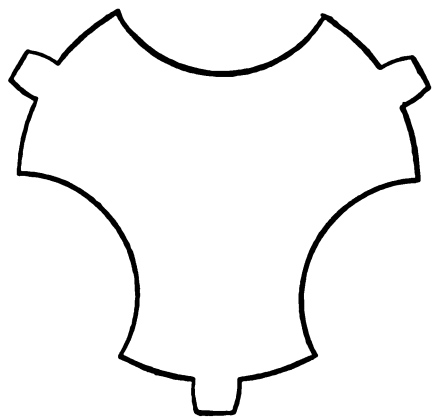


Fig. 174. Baffle Plate

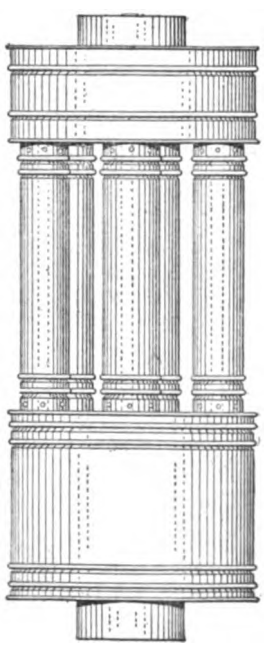


Fig. 175. Pillar Drum

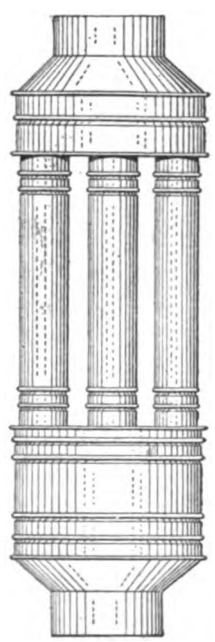


Fig. 176. Sampson Pillar Drum

Many varieties of radiators are in use that can easily be made in any tin shop—viz., the cyclinder, or barrel drum; the plain oval body drum; the pillar drum in connection with round body; the pillar drum in connection with oval body; the descending flue, plain oval body; the descending flue in connection with pillars;

the vertical cylinder drum, with tube; drums with hot air attachments, such as the horizontal, tubular, internal cylinder, etc.

One of the easiest to make, and perhaps the cheapest, is the first mentioned, which is made as follows: For the circumference take three pieces, each 18×24 inches, roll them, and fold along the 24-inch way, then seam them with a mallet on the stove pipe stake, making the surface even on the outside, which gives a better appearance than when seamed with a hand groover. A cyclinder about 16½ inches in diameter and 24 inches deep is the result. Turn an edge at each end with the small turner or large burring machine to take the top and bottom, which should now be cut out, and will need to be about 17⅛ inches in diameter to allow for the edge to be turned over to engage with body. If the body be put through the beading machine, having an ogee swedge in position, it will improve the appearance considerably. The collars at the ends may be formed to fit either 6 or 7-inch pipe, as is desired; if for 6-inch, cut one piece for large end 20⅞×4½ inches, and another the same depth and ¼ inch less in length for small end; for a 7-inch collar cut 23 inches by 4½ deep. Turn an edge on these collars, as shown in Fig. 173, and rivet within them a piece 1½ inches wide, and in length the same as the circumference of the collar, leaving about 3-16 inch projecting past the face of the end, which (when the hole is cut in the drum) is hammered over to secure it to the top or bottom, as the case may be. The construction is clearly shown in Fig. 173, which is alike both top and bottom. A partition, or, as it is sometimes called, a baffle plate, is now made from the pieces that were left after cutting out the ends, and cut to shape, as in Fig. 174, the three projections shown allowing it to be riveted horizontally in the center of the drum. If it is desired to use feet as an additional support, provision must be made for them before putting on the bottom, by riveting thereon three pieces of hoop iron, suitably bent, so as to allow of the insertion or removal of the feet at any time.

In Fig. 175 is shown a useful size of pillar drum. The upper section is made from three pieces of the same material as the preceeding one, each 17⅛×6 inches wide. The best way is to first cut pieces for the ends of the two cylinders—namely, four pieces 18 inches square—thus leaving a piece off each sheet 6×18 inches, three of which will make the upper section previously mentioned. Three pieces 17⅞ inches by 12 wide, put together will make the lower section. Five pillars are used, each 12 inches in circumference and 18 inches long. A small fold is required on these, so that they may be grooved on the machine. The ends of these pillars are fastened in the same manner as the collars shown in Fig. 173 and should be the first thing done when putting the drum together; then the lower and

upper sections (each having an end and collar attached) can be finally joined. They may be used with or without feet, but it is customary to provide three feet.

A very attractive and efficient heater is shown in Fig. 176, which is known as "Samson," a good name too, strong to heat and to wear. The pillars, six in

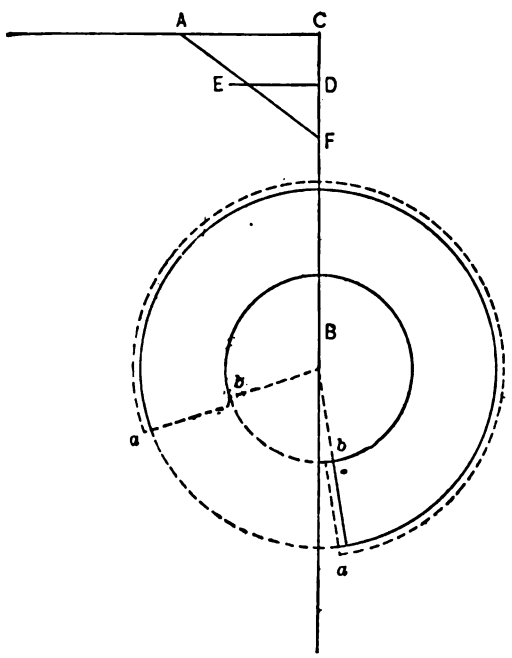


Fig. 177. Pattern for Drum Top

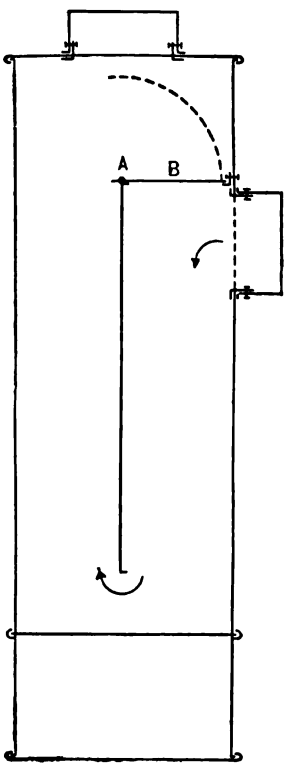


Fig. 178. Section of Descending Flue Drum

number, are each made from sheets $10 \times 17\frac{3}{4}$ inches and are about 3 inches in diameter when finished. Two pieces $4 \times 17\frac{3}{4}$ inches and one piece $4 \times 4\frac{3}{4}$ inches make the circumference of the upper section, and two pieces $8 \times 17\frac{3}{4}$ inches and one piece $8 \times 4\frac{3}{4}$ inches the lower section. The diameter of drum will thus be about 12 inches after allowing for seams. To obtain the cones proceed as follows: With the square set off two lines, as A and B, Fig. 177. Make A C equal to one-half the diameter of large end or base of cone; from C to D is the straight hight, in this case 2 inches. Make E D equal half the diameter of smoke pipe. Draw a line through A E, intersecting B at F. With the compass set from F to A, at any convenient place describe the circle *a a*. Then with the distance F E describe the circle *b b*. With the dividers set from A to C, step off around the outer circle six times and draw lines to the center, and make allowance for all edges needed, as shown by the dotted lines. Put together in the same manner as the aforementioned. No feet are required, but the collars should fit the pipe snugly.

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In some places an oval shape drum may be more desirable than a round one. A cheap one may be made after the manner of the cylinder drum, Fig. 173, the same size, only after swedging form up to an oval 14×19, approximately.

The descending flue, plain oval body, is made in different hights to suit customers. A popular size is shown in section in Fig. 178. It is the same circumference as the plain oval, only, as it is made twice as deep, provision must be made for a small end so as to allow a slip joint to be made in the center, after the manner of a stove pipe. To obtain the oval end proceed as shown in Fig. 179.

Make A B equal to the desired length, 19 inches. Make C D equal the width, or 14 inches. With the compasses set half the distance from A to B and with one leg at C describe the arc E F. Drive pins at E, F and C. Tie a string at E and F, passing around C, then remove C and substitute the point of a lead pencil, which, when moved around, keeping the string tight, will describe

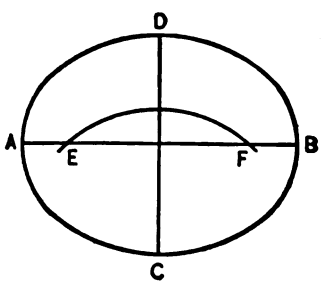


Fig. 179. To Draw an Oval

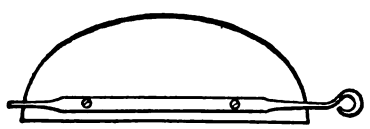


Fig. 180. Plan of Damper

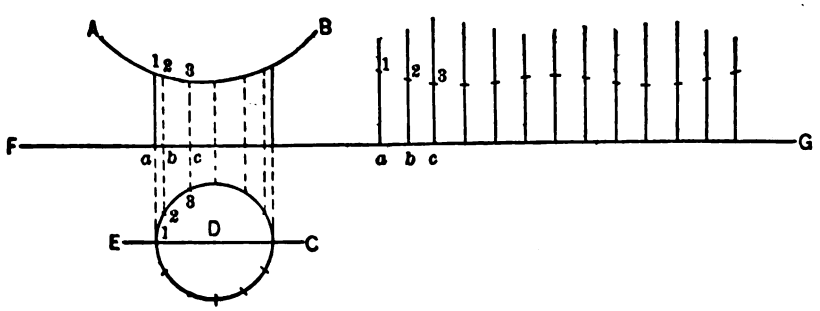


Fig. 181. Pattern for Intersection of Collar

the required oval. The cut, Fig. 178, shows a straight partition, commencing about 1 inch above the inlet collar and extending to within 6 inches of the bottom of drum. This is riveted to the sides for support. At the point A is pivoted the damper B, which when turned, as shown by the dotted lines, allows the smoke to go directly to the chimney. Fig. 180 shows the manner of attaching the handle to the damper by means of two stove bolts passed through that part of the handle which has been flattened for the purpose. A base is provided for this

style of drum 8 or 9 inches deep, wired at the lower edge and perforated. The collar at the side will need to be made on a curve in order to fit properly. To obtain the pattern let A B, Fig. 181, represent the curvature to which the collar is required to fit. Draw the plan D below it and in line with the elevation. Divide it into any equal number of parts and draw line at right angles to E C, cutting the curved line where numbered. Parallel to E C draw the stretchout line F G. With the dividers set equal to one of the spaces in D, step along E G as many times as will equal the circumference of D. Erect perpendiculars as shown, numbering them in order to avoid confusion. These lines are called measuring lines. Transfer the length of the lines in elevation to the corresponding measuring lines—viz.: Make *a* 1 of the measuring lines equal *a* 1 in the elevation, *b* 2 of the measuring lines equal to *b* 2 of elevation, and so on. A line traced through these points will give the pattern required.

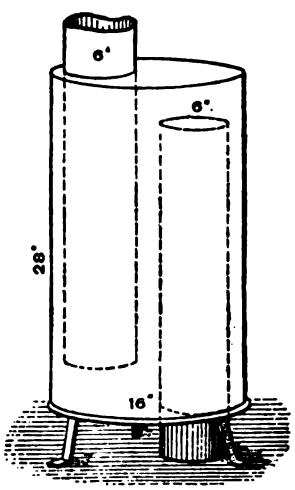


Fig. 182. A Heating Drum

The oval drum with pillars may be made of the same dimensions as Fig. 175, the body being formed oval instead of round and the pillars adjusted to suit the difference in shape.

Another drum, shown by Fig. 182, can be made of Russia iron, 28 inches high and from 14 to 17 inches in diameter, or of smooth black iron 24 inches high and 16 inches in diameter. Continue the pipe or collar on the bottom of the drum upon the inside to about 6 inches from the top, and the outlet pipe at the top of the drum is carried down to within 6 inches of the bottom, as shown in the sketch. This brings the hot smoke to the top of the drum, so that a pan of water can be easily warmed, then the smoke gives off its heat to the drum as it falls to the bottom and passes off through the outlet. The legs are made of the straps that come around bundles of sheet iron and should be about 6 inches high.

A HOPPER REGISTER BOX

In the illustration, Fig. 183, is shown the hopper register box, and it will at once be noted that the boxes, after the patterns are cut, are very easily made and are good goods to handle and show prospective customers when talking up work. It will be readily seen that the air starts to spread over the full surface of the register from the collar to the top of box, and there is nothing to interfere in any way with the register valves or a free outflow of the air.

The way to get the patterns for this box is a simple problem in triangulation, and it is advisable to use this method in getting out the patterns for all stock sizes at least. The hopper is shown in elevation by A B C F E D in Fig. 184. The top square part made to receive the register is represented by A B C D, the hopper proper by D C F E, and the round collar at the bottom of the hopper, to which is fitted the hot air pipe, by E F G H. The half plan of the top of the

Fig. 183. A Hopper Register Box

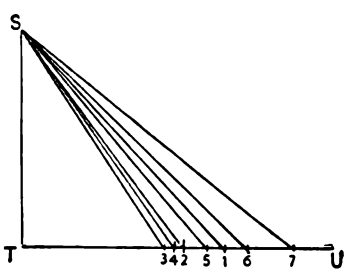


Fig. 185. Diagram of Triangles

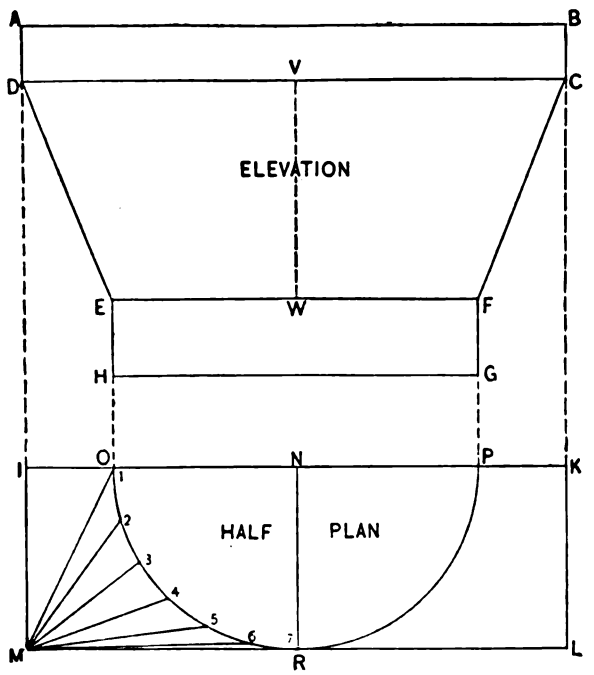


Fig. 184. Plan and Elevation

hopper is represented by I K L M and the half plan of the round bottom part by O R P. To find the pattern of the hopper, D C F E, and the top square part, A B C D, which are made in one piece, divide the quadrant O R into any number of equal spaces, as shown by the figures 1, 2, 3, 4, 5, 6 and 7. From the point M draw the lines M 1, M 2, M 3, M 4, M 5 and M 6, which show the horizontal distances between the point represented by M in plan and D in elevation and the points on the quadrant.

To find the true distances between this point and the points on the quadrant, draw in Fig. 185 the base line T U. At T erect the perpendicular T S, equal to the vertical distances between D C and E F in Fig. 184. From T on the line T U lay off the horizontal distances between M and the points on the quadrant, making T 1 equal to M 1, T 2 equal to M 2, etc. From the numbered points thus obtained on the line T U draw lines to S. These lines will represent the

true distances from M in plan, which is the same as D in elevation, to the numbered points on the quadrant O R in plan, which is E W in elevation.

To make the pattern as shown in Fig. 186 draw A′ B′ C′ D′ equal to A B C D in Fig. 184. It will be seen from the plan in Fig. 184 that the line L M and the point 7 of the arc O R P meet at R, so that the vertical distance between the points V and W in Fig. 184 is equal to the actual distance between these lines. Therefore, in Fig. 186 let fall from the center of C′ D′ a perpendicu-

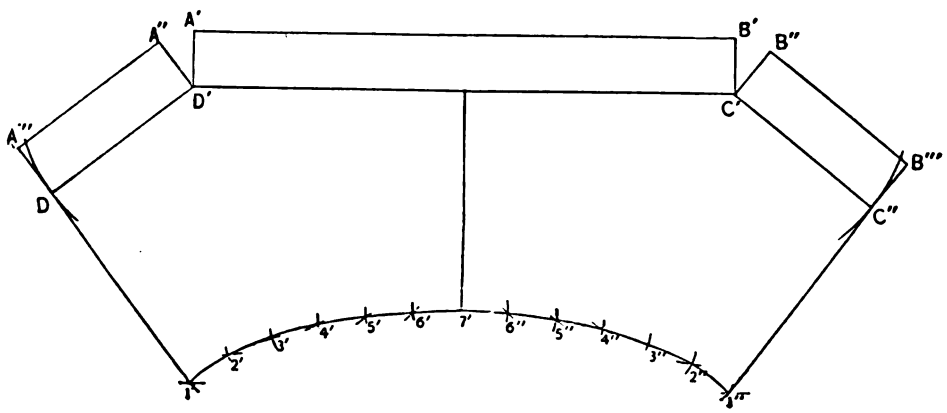


Fig. 186. Pattern for Half of Hopper

lar with a length equal to V W, the vertical distance between D C and E H in Fig. 184, and call the bottom point of the line 7′. Now from 7′, with a radius equal to one of the spaces on the quadrant O R in Fig. 184, strike arcs, and from D′ and C′, with a radius equal to S 6 in Fig. 185, draw arcs intersecting these, marking the intersections 6′. From the points 6′ strike arcs with a radius equal to the spaces in the quadrant in Fig. 184, and intersect these with arcs having centers at D′ and C′, and which have a radius equal to S 5 in Fig. 185, calling these points 5′. Proceed in a similar manner until points 1′ are reached. Trace a curve through the points thus obtained.

From D′ and C′ in Fig. 186 strike arcs equal to I M in half plan in Fig. 184 and intersect these with arcs struck from 1′, with a radius equal to D E in Fig. 184, calling the intersections D″ and C″. Draw the lines D″ D′ and C′ C″. From the points D″, D′, C′ and C″ erect perpendiculars equal to A D in Fig. 184, and connect the top of these perpendiculars, so as to form the rectangles A‴ A″ D′ D″ and C′ B″ B‴ C″. Draw the lines D″ 1′ and C″ 1′. Then will the figure A‴ A″ D′ A′ B′ C′ B″ B‴ 1′ 7′ 1′ be the pattern for half the hopper, no allowance being made for laps.

Attention is called to the way that the joints on the square top of the hopper are made, as shown in Fig. 183, and also to the floor flange which has been pro-

vided and which is an essential part of the hopper. It is usual to make the square box to receive the register about 2 inches deep. As shown in the illustration, Fig. 183, the joints at the corners of this part are simply lapped; if desired these corners can be double seamed, which makes a neater job. After forming up and grooving, a collar is put on the bottom of the box, as shown in Fig. 183, the joints of which are made as in Fig. 188.

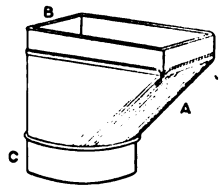


Fig. 187

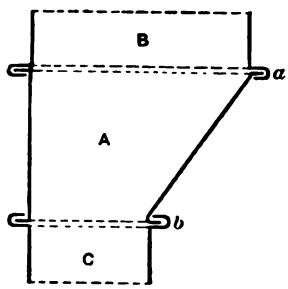


Fig. 188

View and Section Through Offset

The principles explained in the foregoing also apply to "starters," that is, transition pieces, which referring to the transition offset shown in Fig. 187 the part marked A joins a rectangular pipe at B, and a round pipe at C, while Fig. 188 shows how the various pieces B, A and C are seamed together at *a* and *b*. The pattern for an offset of this or any other similar kind is developed by triangulation, as shown in Fig. 186.

PATTERN FOR OFFSET BOOT

The pattern for a boot shown in Fig. 189 is obtained by triangulation without using the plan, and is a method that can be used to advantage when both halves of the article to be made are symmetrical as shown in the plan view in Fig. 190. This method is applicable to any shaped boot, regardless of the size of the pipes at either end or the amount of offset it may contain.

First draw the side elevation of the boot as shown by *a b* 9 1, the profile of the pipe on the line *a b* being a rectangle as shown in plan, and the profile on the line 9 1 being a circle, also shown fore-shortened in the plan. On the line *a b* in elevation place one-half of the rectangular profile *a a' b' b* in plan as shown by similar letters in elevation; and on the line 1 9 place a semicircle representing the one-half profile of the round pipe. As before mentioned, the plan view is not necessary, as the profile of the rectangular pipe would be known without a plan. Divide the semicircle into an even number of spaces as shown from 1 to 9, from which points at right angles to 1 9 draw lines until they intersect the base line from 2° to 8°. All points from 1 to 5° are connected to *a*° and all points from 5° to 9 are

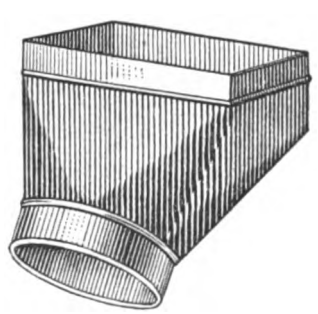
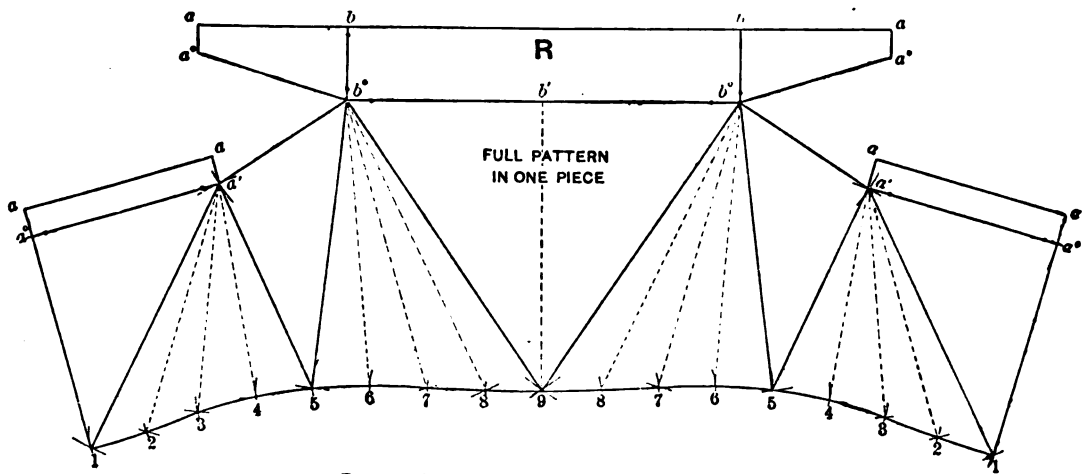


Fig. 189
A One-Piece Offset Boot

connected to $b°$. These lines then give the base lines of sections which will be constructed with altitudes equal to the various hights in both semiprofiles. For example, to obtain the true lengths in Y, take the distances from $b°$ to 5°, $b°$ to 6°, to 7°, to 8° and to 9, and place them on the horizontal line in T as shown by similar numbers. From $b°$ in T erect the perpendicular $b°$ b' equal in hight to



Pattern for an Offset Boot in One Piece.

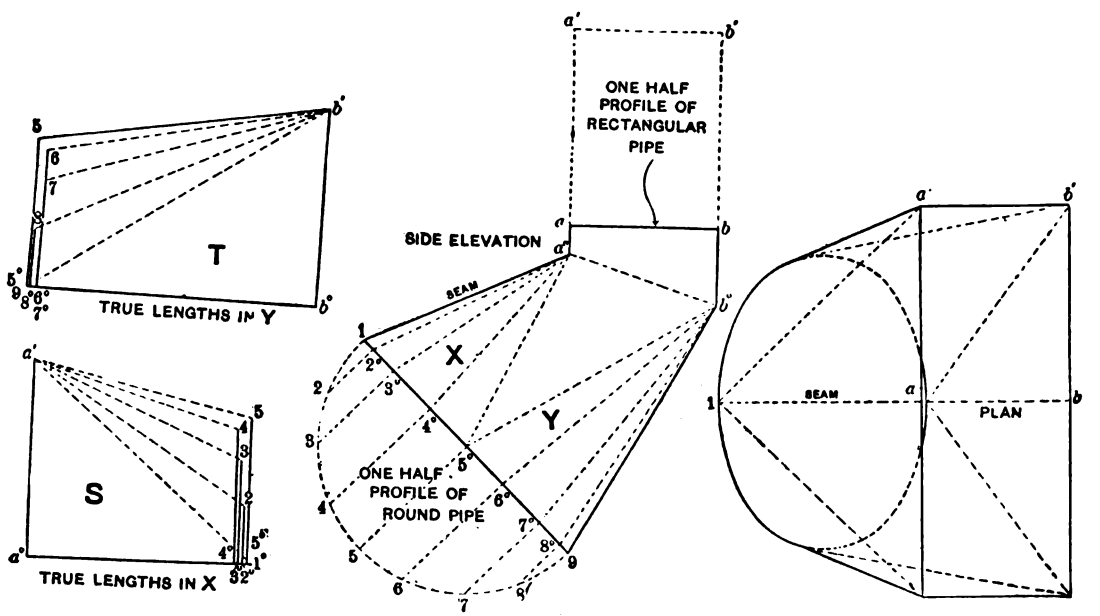


Fig. 190. Details in Obtaining Patterns for an Offset Boot

b b' in the half profile. From the points 5°, 6°, 7° and 8° in T erect the perpendiculars 5° 5, 6° 6, 7° 7 and 8° 8 equal in hight to 5° 5, 6° 6, 7° 7, 8° 8, respectively, in the semicircle in elevation. Then draw lines in T from b' to 5, b' to 6, to 7, to 8 and to 9, each of which represents the true length of a similar numbered line in elevation. In a similar manner obtain the true lengths of the lines in X.

Before laying out the pattern the location of the seam must be known, and in this case the seam will be placed along 1 a° in elevation, which would be at 1 a when viewed in plan. The pattern can now be laid out by taking the distance of 9 b° in elevation and placing it on the vertical line in R, as shown by 9 b'. At right angles to 9 b', through b' draw the line b° b°, making b' b° on both sides equal to b b' in the half profile. Draw lines from b° to 9 in R, which will equal b' 9 in T. With radii equal to b' 8, b' 7, 6 and 5 in T and with b° in R as center, describe the short arcs 8, 7, 6 and 5. Now set the dividers equal to one of the equal spaces in the semicircle in elevation and, starting from point 9 in T, step to arc 8, then to 7, to 6 and to 5, and draw a line from 5 to b°. Next with b° a°

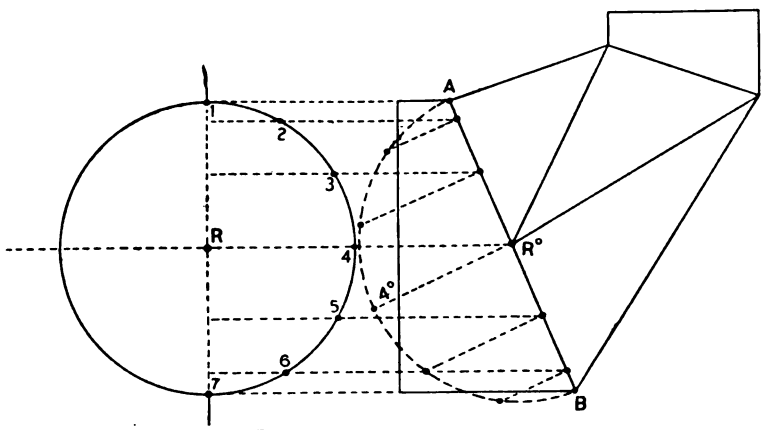


Fig. 191. Boot for Connecting Horizontal Pipe

in elevation as radius, and b° in R as center, describe the arc a', which intersect by an arc struck from 5 as center, with 5 a' in S as radius. Connect lines in R, from 5 to a' to b°, as shown. With radii equal to a' 4, a' 3, 2 and 1 in S, and with a' in R as center, describe short arcs 4, 3, 2 and 1. Then again using the spaces in the semicircle in elevation, step from point 5 to arc 4, to 3, to 2 and to 1, and draw a line from 1 to a'. With the seam line 1 a° in elevation as radius, and 1 in R as center, describe the arc a°, which intersect by an arc struck from a' as center and with radius equal to a a' in the half rectangular profile in elevation. Connect lines in R from 1 to a° to a' and trace a line through the intersections from 1 to 9 on both sides. Then will 1, 9, 1, a°, a', b°, b°, a', a° be the net pattern for the transition piece.

To add the rectangular part shown at the top in Fig. 189, simply take the distance from b° to b in elevation and place it perpendicular to b° b° in the pattern as shown by b° b, and draw a line from b to b. Take a tracing of a b b° a° in elevation and place it as shown by a b b° a° in the pattern. Take the distance of a° a and place it perpendicular to a^1 a° in the pattern and draw the

line *a a*. This then completes the pattern for the offset boot in one piece, to which edges must be allowed for seaming purposes.

It is to be understood that, if this arrangement precludes cutting from stock material, the collar R can be made separately; also a seam could be provided on line *b'* 9. This method is applicable for a boot that is to connect to a horizontal round pipe and would look like Fig. 191. A slight change of procedure is necessary, inasmuch as a section on line A B is an ellipse. This section is ascertained by dividing the circle X into equal parts and carrying lines from these points to the line A B. At right angles to A B and from where these lines intersect it, erect lines that are equal in length to the distance from the center line of the circle; as, 4°—R° of line A B equals 4 R of the circular section.

SHORT RULE FOR STRAIGHT BOOT PATTERN

In Fig. 192 is shown a finished view of a straight boot from oblong to round used in ventilation and heating work. In this article the proposition is to obtain the half-pattern for A, with seams at the sides, as shown by B by a short rule. The usual rule is to obtain the plan and elevation of the article, then divide the plan in equal spaces and obtain the base lines of the sections the vertical hights of which would be equal to the hight of the article. In this case the plan is omitted, as will be seen in Fig. 193, which shows a simple method for obtaining an accurate pattern.

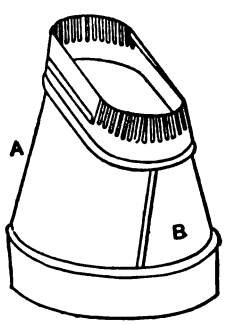


Fig. 192. View of the Finished Boot

First draw the center line, upon which place the hight the boot is to have, as shown by *a* 1'. Draw horizontal lines through *a* and 1', making 5 5' equal to the length of the oblong pipe, and 4 4' equal to the diameter of the round pipe.

Place the half profile of the oblong pipe in the position shown by C, and the half profile of the round pipe in the position shown by B. As the four quarters of the article are alike it is only necessary to divide the quarter circle in B in equal spaces, as shown from 1 to 4, and the quarter circle in C into a similar number of spaces, as shown from 5 to 8, 8 8' being the semidiameter of the circular ends of the oblong pipe.

From the various divisions 1 to 4 and 5 8 lines are drawn at right angles to their respective base lines, intersecting them from 1' to 4 and 5 to 8'. Solid and dotted lines in A are now drawn, as shown, which represent the bases of sections to be constructed, the altitudes of which are equal to the various hights in the semi-

profiles B and C. For example, the true section on 1′ 8′ in A is obtained by placing this distance on the horizontal line 1′ 8′ in D and erecting the perpendiculars 1′ 1 and 8′ 8, equal, respectively, to 1′ 1 in B and 8′ 8 in C; 1 8 in D then gives the true length on the finished article on the line 1′ 8′ in A. Diagram D shows the true lengths of the solid lines in A, while in E are shown the true lengths of the dotted lines in A.

The pattern for one-half the boot is shown in Fig. 194, in which the distance 9 8 is equal to 9 8 in C in Fig. 193. With the radius equal to 1 8 in D and 8 and

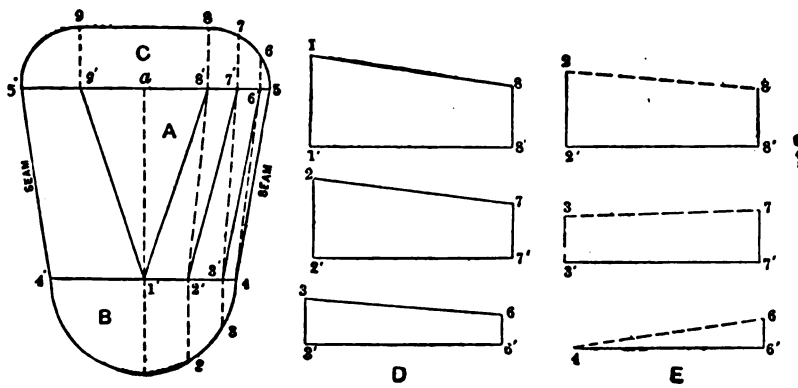


Fig. 193. Elevation, Half Profiles and Sections

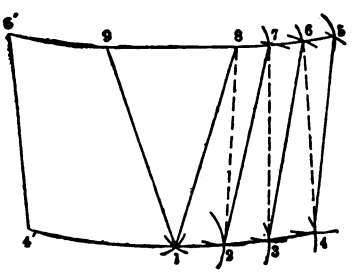


Fig. 194. The Half-Pattern Shape

9 in Fig. 194 as centers, arcs are struck intersecting each other at 1. With 1 as center describe the arc 1 2 with a radius equal to 1 2 in B in Fig. 193. With radius equal to 2 8 in diagram E and 8 in Fig. 194 as center intersect the arc 2 at 2.

Using 8 as center, describe the arc 7 with a radius equal to 8 7 in C in Fig. 193. Then using 2 7 in diagram D as radius and 2 in Fig. 194 as center describe an arc intersecting the arc 7.

Proceed in this manner, using alternately first the divisions in the profile B, in Fig. 193, then the true length in E, the divisions in the profile C, then the true length in D, until the line 4 5 in Fig. 194 is drawn, which is obtained from 4 5 in A, in Fig. 193. Trace 1 4, 5 8 in Fig. 194 opposite the line 1 9, as shown by 1 4′, 5′ 9 which completes the half-pattern, to which edges must be allowed for seaming.

PATTERN FOR FURNACE PIPE FITTING

The following is a demonstration of the method of obtaining the pattern for a furnace pipe fitting shown by Fig. 195. As will be seen, this is a transition fitting, which makes a quarter twist for a line of piping. It is emphasized that such a fit-

ting is frequently useful between a floor and the ceiling below, where a square box with collars attached is generally used. This, of course, is unscientific and requires more space, necessitating considerable additional cutting away of the timber. Naturally, such a fitting affords, in a large measure, obstruction to the flow of the air, as it does not provide an easy transition from one portion of the line of piping to another, whether the line is vertical or otherwise.

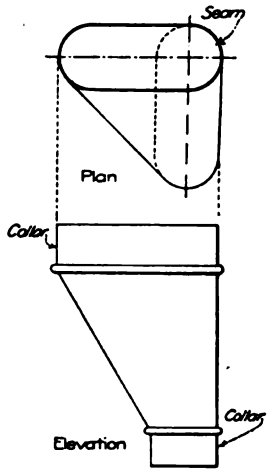


Fig. 195. Pattern Problem

In laying out this article a plan is the first essential. The plan of Fig. 195 is to be redrawn as in Fig. 196. By studying the problem it becomes evident that the object is composed of triangular and cylindrical surfaces which alternate. Inasmuch as the elements of a cylindrical form are always parallel, the obvious conclusion, it would seem, is to develop these surfaces by the parallel line method. As three of these surfaces are inclined, however, with but one vertical, and its true section shown by the plan, this surface being the one designated 13 to 17, the question arises, would the method suggested be preferable to triangulation?—because true sections are, perforce, required of the inclined surfaces to develop the pattern by the parallel method.

By experimenting with both methods, it is learned that the parallel methods are decidedly quicker and insure the greater accuracy by reason of the elimination of the dotted lines required by triangulation to connect the elements. For this exemplification, therefore, the procedure will be by the parallel method.

The plan is divided into spaces as shown by 1 to 30, and the elements of the various cylindrical surfaces represented by dot and dash lines as shown. The triangular surfaces are also shown by certain lines, as 13 30, 9 26 8, 21 4 22. It is purely a fortunate accident that some lines pass through two points, as line 4 26 is for two triangles.

The true sections of the cylindrical surface are determined in this wise: For the surface 9 13 to 30 26 an elevation is drawn by projecting the division points upward. On the line 31 32 the hight of the fitting is placed. Horizontal line 32 33 terminates the elements at the top, and line 31 34 at the bottom. From the point where the projectors drawn from 30 to 26 in plan intersect line 31 34, lines (the elements) are drawn to where projectors from 13 to 9 intersect line 32 33. These lines are parallel, and 32 33 34 31 is a partial elevation of the fitting, giving the exact lengths of the lines of the triangular surface 13 30 in plan, also of the element of the cylindrical surface 13 9 30 26 of the plan. Although it is not a true eleva-

tion, it will suffice for the triangular surface 17 0 and cylindrical surface 17 21 0 4 of the plan.

The ascertaining of the true section is now in order and is done in this fashion: A line A B is drawn perpendicular to the elements in the elevation. Measuring from this line on each element, the distances in plan are placed, as 30 R in plan is 35 S in elevation, etc.

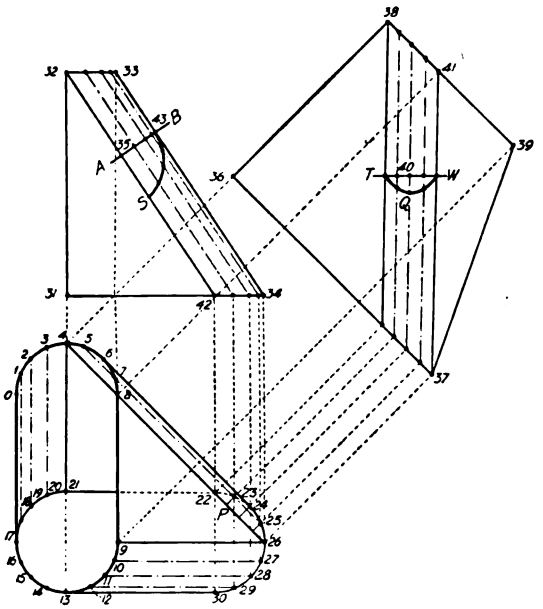


Fig. 196. Development of Elements of Fitting

An oblique view is necessary for the finding of the right lengths of the elements and the true section of the surface 26 22 8 4 as follows: A line 36 37 is drawn parallel to the plan lines and another line 38 39 the distance away of 31 32. Projection lines are drawn to this from the plan, as instructed for the other elevations. In a like manner the true section is found on the line, using the distances as 23 P in plan is 40 Q in the elevation. The triangular surface is not shown true in this elevation, owing to the plane in plan 8 9 26 being fore-shortened in elevation 37 39 41.

The sides of this triangle having been already obtained in the elements of the curved surfaces, also the other slanting triangular surface 4 21 23, no further work is required, leaving the developing of the pattern still to be accomplished, to wit: As the seam is stipulated to be at point 16 in plan, a stretchout of that surface is placed anywhere, as 16 to 13 in Fig. 197. To this is annexed the triangular surface 13 30 in plan; that is, 32 31 42 in elevation is transferred to the pattern, as shown by 13 T 30 13. To these are attached the stretchout of the cylindrical surface 13 9 30 26 in plan, by drawing, in Fig. 197, a line A A B B with the stretchout points of the true profile perpendicular to 13 T 30 the same distance from 13 T that A B of Fig. 196 is from 32. The most convenient way to carry the elements to the pattern is to take the distances on the various elements in Fig. 196 from line A B to 32 33 and A B to 42 34; like the space 33 43 of Fig. 196 coincides with 9 43 of Fig. 197.

Line 9 26 of Fig. 197 is one side of the triangular surface 9 26 8 of the plan, Fig. 196. With the compasses or trammels spaced to 9 8 of Fig. 196, swing an arc from 9 as a center, Fig. 197. With the compasses now set to the distance

37 41 of the oblique elevation, Fig. 196, and 26 as center, Fig. 197, swing an arc to intersect the arc just drawn, giving the point 8 or the exact triangular surface.

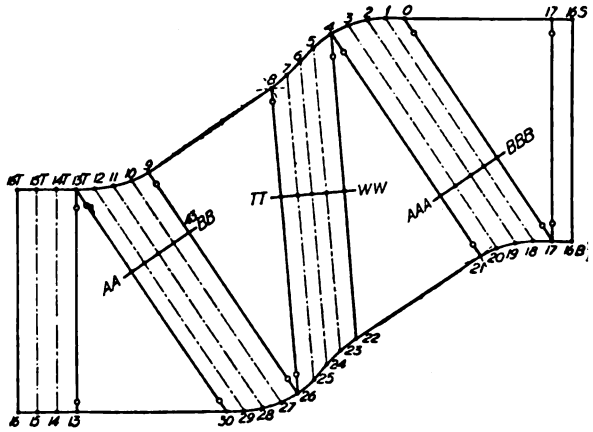


Fig. 197. Development of Pattern

The elements of the cylindrical surface 26 22 8 4, Fig. 196, are appended to this much of the pattern, as per former instructions. The triangular surface 21 4 22 of Fig. 196 is obtained by swinging an arc of a length coincident to 21 22 of Fig. 196 with 22 as a center in Fig. 197. From 4 swing an intersecting arc of a length equal to 42 32 of Fig. 196.

The rest of the pattern is simply the repetition of the first part of the pattern, from 14 T to 9 to 14 to 26 as shown; inasmuch, as stated, the elevation of Fig. 196 would suffice for two of the cylindrical and triangular surfaces combined. In conclusion, it is suggested that the pattern be made in two parts with an additional seam at, say, line 7 26. This is suggested to allow of cutting with little waste from standard sizes of tin plate.

From the foregoing solution the method of obtaining the pattern for a fitting of an oblong pipe, that is to say, a pipe with four flat sides or rectangular in section, should be clear, because flat surfaces are only dealt with, making it much more simple.

PIPE INSERTING FURNACE TOP

In Fig. 198 A B C D represents part of the furnace top and E F J G the pipe, which joins the top at an angle in elevation indicated by B K E, and at an angle in plan, Fig. 199, by Z. In this connection it may be proper to remark that no matter what size of furnace top or what size pipe is used, or at what angle the pipe is placed in plan or elevation, the principles here shown are applicable in any case. Referring to Fig. 199 let A B C D represent the elevation of the furnace top, the half-plan of which is shown by E F G H I J K. Let J G in plan represent the angle at which the pipe is to be taken off the top, and let L in elevation represent the hight which the side of the pipe H of Fig. 198 will be above the base line of the cone in elevation in Fig. 199. At right angles to D C, and from the point L, draw a line intersecting the center line E H of the plan at T^1. With J in plan as center, and J T^1 as radius, describe an arc intersecting the line J F,

which is drawn at right angles to J, G, at X^1. Then at pleasure locate the point where the side of the pipe, indicated at H of Figs. 198 or 200 in the profile N of Fig. 199, should touch in plan, as shown by the point M. Now through the point M, and parallel to J G, draw the line M S, prolonging it until it intersects the line J F at R. At right angles to R S draw the line S P, equal to the width of the pipe, and parallel to R S the line P O, as shown. In line with the pipe draw the profile N, which divide into equal spaces, as shown by the small figures. Through the small figures, and parallel to P O, draw lines intersecting the arc G F and line J F, as shown by O Z, S T, V U, W X and R Y.

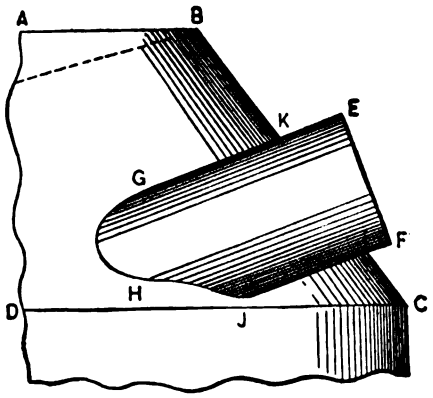


Fig. 198. Shape for which Pattern is Desired

With J in plan as center, and with the various radii shown from J O to J R, describe arcs intersecting the line E H at N^1, O^1, P^1, R^1, and S^1. At right angles to E H, and through the various intersections, draw lines intersecting the side of the cone B C in elevation at C^1, E^1, G^1, J^1, L^1. Parallel to D C, and from the intersections on B C, draw lines intersecting the center line A^1 M^1 at B^1, D^1, F^1, M^1, K^1, V^1. Then will the arcs O N^1, T O^1, V P^1, etc., represent sections of the cone in plan corresponding to the lines B^1 C^1, D^1 E^1, F^1 G^1, etc., shown in elevation.

The next step is to construct sections of the cone as it would appear if cut by the lines shown in plan by O Z, T S, U V, X W, and Y R. To avoid a confusion of lines the method has been shown separately in Fig. 200.

All that part of the plan in Fig. 199 contained in G J F has been transferred as shown by G J F in Fig. 200, the line J F of Fig. 199 being placed vertical in Fig. 200 because the sections of the cone will be taken at right angles to the line of the pipe O P. Having placed the plan in Fig. 200 in the proper position, draw any horizontal line, M^1 C representing the base of the cone in its relative position to the plan, as shown by the dotted lines. Now upon this base line M^1 C construct the half elevation of the furnace top, containing the lines representing the sections in plan, similar in all respects to A^1 B C M^1 of Fig. 199, as shown by C M^1 A^1 B in Fig. 200. For the section of the cone on the line O Z in plan, Fig. 200, proceed as follows: At right angles to the line O P in plan, and from the intersections on the arcs shown, carry lines upward, as shown by the dotted lines, intersecting lines in elevation corresponding to the arcs in plan. A line traced through the intersections thus obtained, shown from B^1 to B^2 in elevation,

will be the section of the cone if cut on the line O Z in plan. The sections on the lines S T, U V, W X and Y R in plan are obtained in the same manner as shown by the sections D^1 D^2, F^1 F^2, H^1 H^2 and K^1 K^2 in elevation, all the lines not being carried through from plan to elevation, the points of intersections only being shown, so as to avoid a confusion of lines. From the point M in plan,

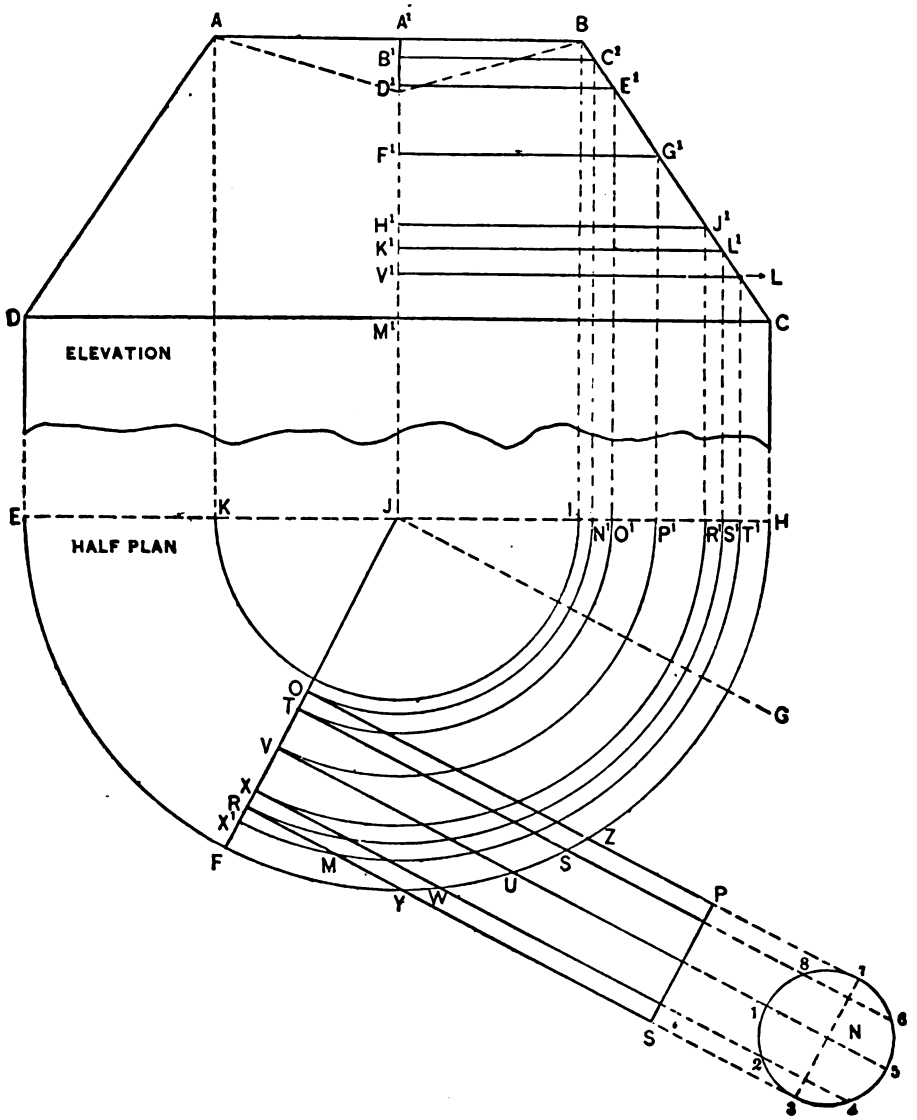


Fig. 199. Half-Plan and Elevation

Fig. 200, which indicates the position of the point 3 of the pipe, shown by H in Fig. 198, and at right angles to R S in plan, Fig. 200, draw a line intersecting the one drawn from the point L in elevation, as shown at 3. Then will 3 indicate the position of the point 3 of the pipe, shown by H in Fig. 198. Let B Q U^1 represent the angle at which the pipe is to come in elevation; then from the point

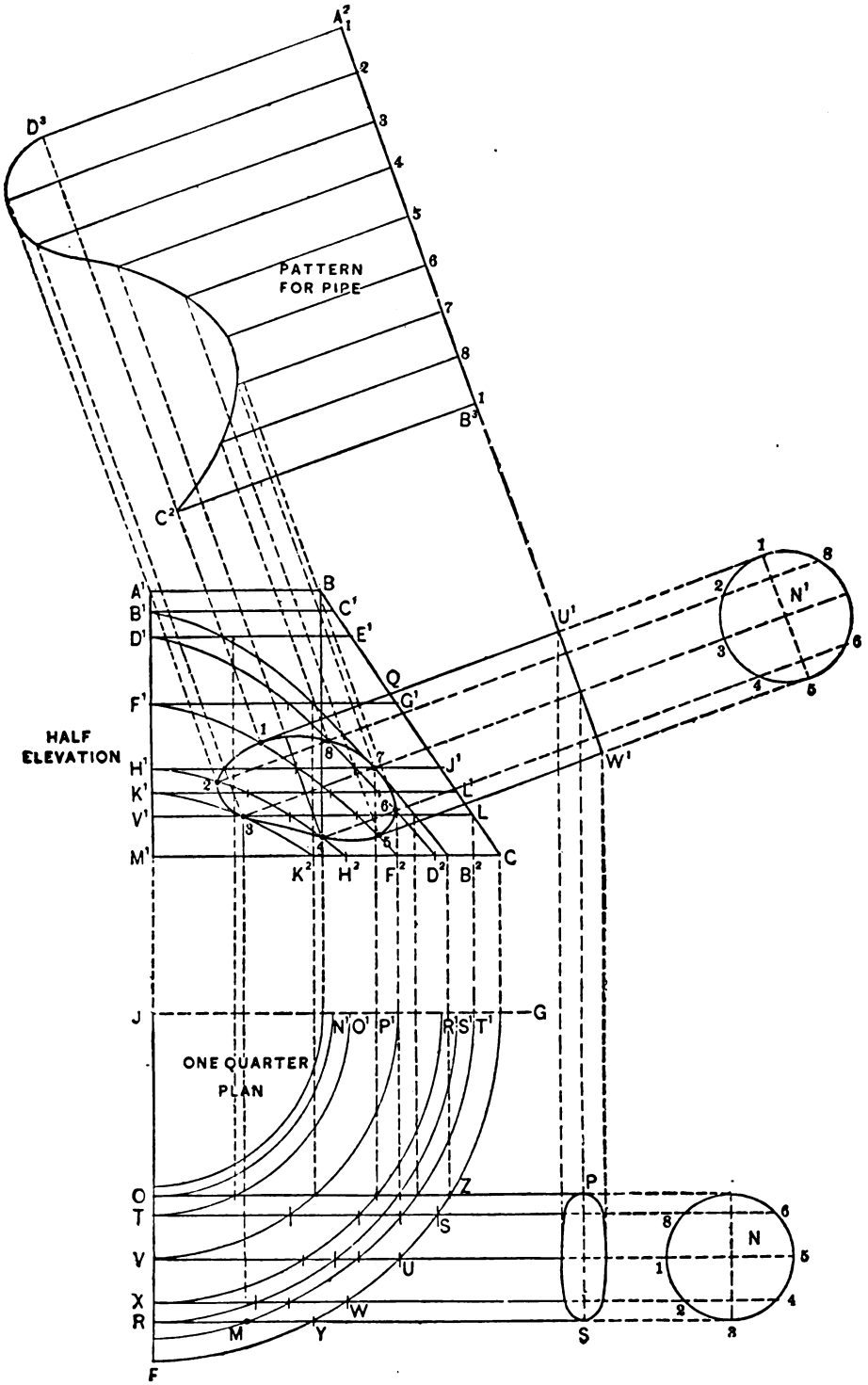


Fig. 200. Miter Line and Pattern for Pipe

3 obtained in elevation, and parallel to Q U^1, draw the dotted line 3 7. At any convenient point on the line 3 7 as center, and with radius corresponding to the profile N in plan, draw the profile N^1, as shown. As the point 1 in plan in profile N represents the top of the pipe, this point must be placed as shown at the top of the profile N^1 in elevation. Now divide the profile N^1 into the same number of equal parts as shown by the profile N.

The next step is to obtain the miter line or line of joint in elevation between the cone and pipe. By referring to the plan it will be seen that the point 7 lies in the plane of the section O Z; then must a line from point 7 in profile N^1 cut the profile B^1 B^2, which corresponds to the line O Z in plan, as shown by 7. The points 6 and 8 in the profile N in plan being in the plane of the section T S, then must the correspohding points 6 and 8 in the profile N^1 intersect the section D^1 D^2. In this manner is the balance of the points 1, 2, 3, 4 and 5 in the profile N^1 intersected with sections in elevation, as shown by the intersections 1, 2, 3, 4 and 5 in half elevation. A line traced through these points of intersections, as shown, will be the miter line, showing the intersections between the pipe and cone of the angle desired.

For the pattern for the pipe proceed as follows: At right angles to the line of the pipe Q U^1 draw the line A^2 B^3, upon which place the stretchout of the profile N^1, as shown by the small figures. At right angles to A^2 B^3, and through the small figures, draw lines, which intersect with lines of corresponding numbers drawn from the points of intersections on the miter line in elevation at right angles to Q U^1. Trace a line through the intersections thus obtained, as shown from D^3 to C^2. Then will A^2 B^3 C^2 D^3 be the pattern for the pipe mitering against the cone at the angle shown in plan and elevation. To obtain an accurate fit and the correct angle, a pattern must be obtained for the opening to be cut into the side of the cone. The method of obtaining this pattern has been shown in Fig. 201, which avoids this confusion of lines which would occur if the pattern were obtained from Fig. 200. Thus A^1 B C M^1 in Fig. 201 is a reproduction of A^1 B C M^1 in Fig. 200. Likewise the plan J G F, the pipe O P S R and profile N in Fig. 201 are a reproduction of the quarter plan J G F, etc., as shown in Fig. 200. From the points in the profile N of Fig. 201 draw horizontal lines through the plan, as shown. Now obtain a duplicate of the miter line 1 2 3 4 5 6 7 8 in elevation, Fig. 200, and place it in the same relative position, as shown by 1 2 3 4 5 6 7 8, in the half elevation, Fig. 201. Now, at right angles to M^1 C, and through the small figures in the miter line in elevation, draw lines intersecting those of similar numbers in plan, as shown by the figures 1, 2, 3, 4, 5, 6, 7, 8.

B′ H′ may be extended to K, making H′ K equal to B′ H′, as shown by the eight additional spaces.

To find the radius with which to describe the pattern for the sides of the furnace top, extend the line B D of the sectional view upward until it intersects with the center line A C extended at L. Then will L B and L D be respectively the radii for the upper and lower edges of the side pieces. From L as center, with these radii, describe the arcs B M and D N, as shown, and make the arc D N equal in length to the arc G F of the plan, as shown by the corresponding equal spaces in both. Then will B M N D be the pattern for one-quarter of the side piece. The necessary edges for joints should be allowed.

PATTERNS FOR RECTANGULAR FURNACE HOOD AND DEFLECTOR

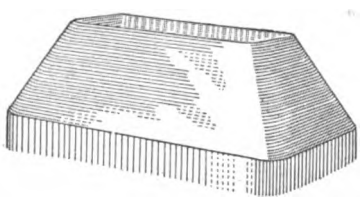


Fig. 203. Perspective View of Hood and Deflector

The problem is, where a flaring rectangular furnace hood, with rounded corners, is intersected by a flaring rectangular deflector, with rounded corners, to find the patterns for the hood and deflector, such as is shown in Fig. 203. It may be well to say that it makes no difference what size or shape this hood has, as the principles here laid down are applicable to any case.

First draw the plan of the bottom of the hood, as shown by A B C D in Fig. 204, the rounded corners being quarter circles struck from the centers *a*, *b*, *c* and *d*, as shown by *k j*, *s r*, *o n* and *m l* respectively. As the flare of the hood is be equal on all sides, and knowing the pitch, construct the plan of the top of the hood, as shown by E F G H, the corners also being quarter circles, struck from the centers *e*, *f*, *h* and *i*, with the same radii as used for the bottom, These arcs are shown respectively by *u t*, *t′ u′*, *v′ w′* and *w v*. From the plan project lines and construct the elevation, as shown by K L M N. Also draw the elevation of the deflector, as shown by M N P O, which is to have equal flare on all sides, as shown in plan by E F G H I J, the rounded corners on both ends tapering to I and J, as shown.

To obtain the patterns for the flat side and end of the hood proceed as follows: At right angles to the side and the end of the hood in plan draw the lines N^1 L^1 and N^2 L^2, equal in length to N L in elevation. Through the points N^1 and L^1 parallel to *m n* draw lines, as shown, which intersect with lines drawn at right angles to *m n* from points *w w′* and *m n*, as shown by *w″ w″* and *m″ n″*. Draw lines from *w″* to *m″* and *w″* to *n″*, and the figure obtained is the pattern for the flat side of the hood.

A line traced through these points of intersection, as shown by the shaded portion, will represent the shape of the opening to be cut into the side of the funnel top, of which I H F^1 G^1 represents one-quarter.

PATTERNS FOR A CONCAVE FURNACE TOP.

The concave top constitutes an inverted cone with a base 9 feet 8 inches in diameter and has an altitude 4 inches. The radius with which to describe the pattern will be the slant hight of the cone, found by constructing a diagram of the same, either full size or with accuracy to a scale not less than one-fourth full size. In the accompanying illustration Fig. 202, A C represents the vertical center line of the furnace top. Draw A B and C D horizontally 13 inches apart, representing respectively the upper and lower lines of the article. Measuring from the center line, make A B 4 feet 10 inches long, one-half the required upper diameter and make C D 5 feet 5 inches long, one-half the required lower diameter, and draw B D. Also set off on the center line the point E 4 inches below A and draw A B, thus completing a sectional view of the furnace top. Then will E B be the radius for the pattern of the concave top, as above described, the pattern being shown in the upper part of the diagram.

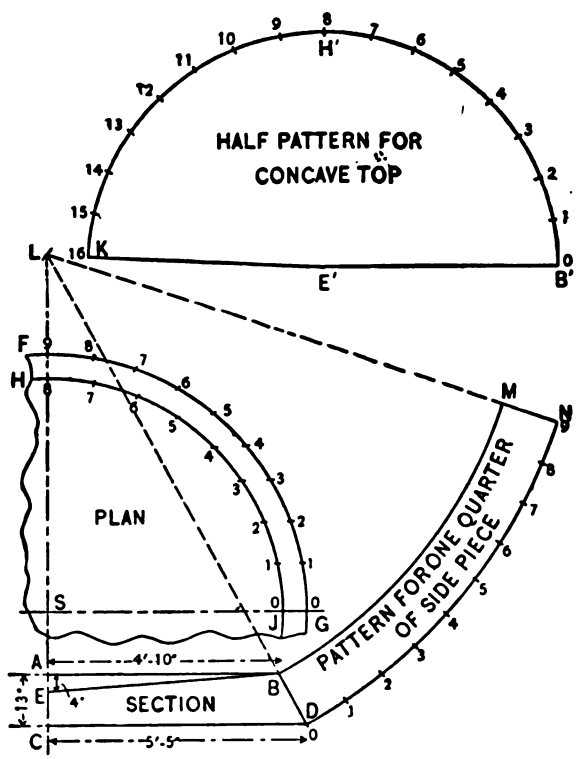


Fig. 202. Method of Obtaining Patterns.

To obtain the circumference of the pattern it will be necessary to first construct a quarter plan of the top. Therefore, from any point, as S on the center line extended, with radii equal to A B and C D, describe the quarter circles H J and F G, terminating them at the top against the center line and at the bottom, at the line S G, drawn horizontally from the point S. The circumference of the quarter circle H J, as measured by the equal spaces designated by the points 1 to 8, may then be set off on the line B′ H′ of the pattern, as shown, and if one-half the pattern should be required in one piece the arc

At right angles to c'' h''' draw the line S T. Measuring from the line c 2 in plan, take the distance to points 1 and 3 and place it on similar numbered lines in diagonal elevation, measuring from the line S T, thus obtaining the points $c°$, 1°, 2° and 3°, through which trace a line, as shown, which will be the true section of points h, 1′, 2′ and 3′, of the rounded corner at right angles to the diagonal elevation. For the pattern for the rounded corner draw the line U V at right angles to 2″ 2‴, upon which place the stretchout of the true section 1°, 2°, 3°, as shown by 1, 2, 3 on U V. Through the small figures, parallel to 2′, 2‴, draw lines, which intersect with lines drawn at right angles to 2″ 2‴ from similar numbered points on the top and bottom of the diagonal elevation. Trace a line through points thus obtained, as shown; then will W X Y Z be the pattern for the corner, which can be added to the pattern for side, as shown by A^1 and B^1.

For the pattern for the deflector, space one of the corners into an equal number of parts, as shown by t E u, and draw lines to the apex I. In practice more spaces should be used. M O in elevation represents the true length on x I and I y in plan. To obtain the true lengths on I t, I E and I u a diagram of triangles must be constructed as follows: Extend the lines N M and P O in elevation, as shown. Take the distance of I t or I u in plan, both of which are the same, and place it as shown by I^1 $t°$ in the diagram of triangles. In similar manner take the distance I E in plan and place it as shown by $t°$ E^1 in diagram of triangles. Erect perpendiculars I^1 I^2 and $t°$ I^3, as shown, and draw the lines I^2 $t°$ and I^3 E^1, which represent respectively the true lengths in plan on I t or I u and I E.

For the half pattern of the defiector take the distance of O M or P N in elevation and place it at right angles to M N, as shown by P^1 N^1. Through these two points parallel to M N draw lines, as shown, which intersect with lines drawn from points t, I, t' and J in plan at right angles to I J, thus obtaining the points t^x, I^4, t^x and J^1 in pattern. Draw lines from t^x to I^4 and t^x to J^1, which should equal I^2 $t°$ in the diagram of triangles. With radii equal to I^2 $t°$ and I^3 E^1 in the diagram of triangles, and with I^4 in pattern of deflector as center, describe the arcs t^x t u and E° E, respectively, as shown. Set the dividers equal to t E and E u in plan, and, starting from the point t^x in pattern, step to similar lettered arcs, thus obtaining the intersections E° and u^x respectively. Draw a line from u^x to I^4, and trace a curve through points t^x, E° and u^x. With u x in plan as radius and u^x in pattern as center describe the arc x'', which intersect with an arc struck from I^4 as center and N^1 P^1 in pattern as radius. Draw a line from u^x to x'' to I^4. In similar manner obtain C^4 or the opposite side. Then will the outline shown represent the half pattern for the deflector in the top of the furnace hood.

PATTERNS FOR A FURNACE BOOT

Of late furnacemen are more careful to design fittings that permit the flow of air with the minimum amount possible of friction and with no reduction of area in any part of the fitting. The elevation shown in Fig. 206 is constructed in accordance with the dimensions given in the sketch, Fig. 205, but the proportions of the boot may be varied to suit any depth of joist, amount of offset or dimensions of pipes necessary to make it conform to any other set of conditions, without in the least affecting the method of developing its pattern. The reader will, of course, understand that if the proportions are varied materially from those shown in the diagrams, the results will differ correspondingly from that shown in the pattern given, but he need have no fear of error if the method herein prescribed be adhered to.

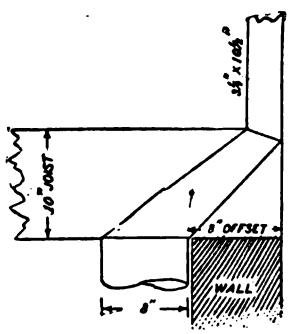


Fig. 205. Diagram of the Problem

First draw the plan with its two pipes P and Q, centered upon the horizontal line C E, placing them so that the distance D E shall equal the required offset. Next construct the elevation by projecting lines upward from each point on C E of the plan, as shown, giving B the required vertical hight above D. Some liberty may be permitted with regard to the location of point C in this view. The line C D can of course be drawn horizontally as in Fig. 205, but the function of the boot is naturally that of an elbow, and the capacity of the offset will be greatly reduced if the point C is placed on the same level with D; for it will be seen that if this is the case the distance across the boot from D to the line C B will then be much less than the diameter of the round pipe P, and further, that this narrowing will be increased as the amount of offset is increased, by reason of the increased obliquity of the lines. It is therefore necessary to elevate the point C to such a hight that the area of a section on a line, D *e*, drawn from D perpendicular to C B of the elevation, is equal to that of the round pipe P, or to that of the rectangular pipe Q, whichever may be the lesser.

It may be noted that the distance across the elevation above referred to need not be quite as great as the diameter of pipe P, from the fact that, while the distance across the boot, as seen in the side elevation, decreases from C D toward B A, the distance across, as shown by the plan, increases in the same direction, while at the same time the section is becoming more and more rectangular as B A is approached. For a like reason it will be seen that the point A of the elevation should be lowered till the line A D falls outside the point of tangency to an arc drawn from B as a center, with B *a* as radius, as shown, since the horizontal width

of the boot is decreasing from B A toward C D. These details involve no complication or difficulty in the work of developing the patterns, since the pattern for the round pipe becomes thereby the same as that for an ordinary elbow, and takes the place of a developed section on C D as a means of obtaining the true distances along the lower end of the pattern of the boot.

Having completed the plan and elevation, to develop the elbow pattern just referred to, construct a diagram of triangles by means of which to determine the true distances across the pattern of the boot from A and B to certain assumed points in the perimeter at C D, all preparatory to laying out the pattern of the boot.

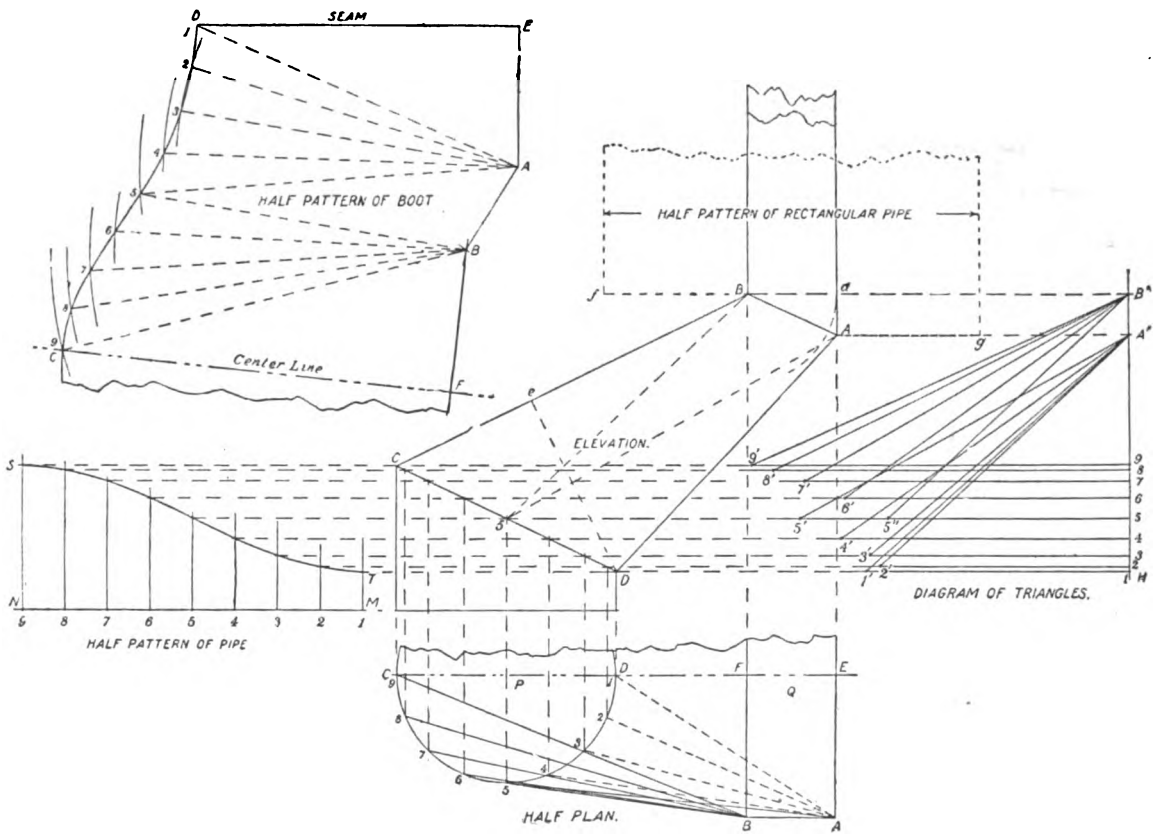


Fig. 206. Method of Laying Out Furnace Boot Pattern

First divide the profile C D of the plan into any convenient number of equal spaces, as shown by the figures, and set off the stretchout on M N, erecting the measuring lines in the usual manner. Carry lines vertically from the points in C D of the plan to cut C D of the elevation. Projections must be made from the points on C D into the measuring lines of the stretchout in developing the pattern of the straight pipe P, all as shown at the left, and also into any convenient space for constructing a diagram of triangles. The several parts of the drawing involved

have therefore been so arranged as to accomplish this result with the least possible labor. As the T square is brought successively to the several points on C D of the elevation in making the projections into the measuring lines of the stretchout, which may for convenience be placed to the left of the elevation, carry lines also in the opposite direction to cut a vertical line B′ H, erected as close as convenient to the elevation, numbering each of the horizontal lines to correspond with the point of the plan from which it was derived, as shown by the small figures above H.

Next in order will be the arrangement of the triangles the development of which will constitute the pattern for the boot. This must be done on the plan in the following manner: Connect point A with each of the points 1 to 5, inclusive, of the plan C D, and point B with the points 5 to 9, inclusive. These lines will represent the horizontal distances between the several points in the lower base C D of the boot and the points A and B in the upper end, and will form the bases of a series of right angled triangles the altitudes of which will be the distances from the several points 1 to 5, inclusive, to A′, and from 5 to 9, inclusive, to B′, as measured along the line H B′. Therefore, on each of the horizontal lines cutting H B′, set off the length of the base line of the plan of corresponding numbers; thus make the distance H (1) 1′ of the diagram of triangles equal to A 1 of the plan, 2 2′ of the diagram equal to A 2 of the plan, etc. Lines drawn from the several points, 1′ to 9′, inclusive, thus located to A′ and B′, as shown, will give the true distances from A and B of the pattern to corresponding points in its lower outline.

These measurements cover all of those portions of the pattern forming the rounded corners of the boot, each conical in shape, their bases uniting to form the elliptical opening C D and with apexes at the four points A and B. Besides these corners, there then remain four flat triangular sides, two of which are shown by B 5 A of the elevation, while the plan shows by F B C and E A D one-half each of the other two.

To lay out the pattern of the boot, first take the length along the center line of the side in which it is desired to have the seam, as D A of the elevation, and set this distance off on any straight line, as D E of the pattern, and from E draw E A at right angles to D E, making it equal in length to E A of the plan, and draw A D, which will be equal to A′ 1′ of the diagram of triangles. Now from A of the pattern as center, with radii equal to A′ 2′, A′ 3′, A′ 4′ and A′ 5′ draw the several arcs shown in the pattern between D and 5 giving to each its proper number. As intimated above, the measurement along the lower side line of the pattern of the boot must be equal to that along the upper side of the

pattern of the pipe; therefore set the dividers to the first space (1 to 2) on T S, and placing one foot of the dividers at D or 1 of the pattern, swing the other foot around to cut arc 2 just drawn in the pattern, thus locating the point 2 of the pattern. Now from 2 as center with a radius equal to 2 3 of the line T S describe an arc cutting arc 3 of pattern locating point 3. As A′ 2′ and A′ 3′ of the diagram of triangles are in this case equal, one arc answers for both in the pattern. This operation is continued to complete the lower outline of the pattern, stepping from one arc to the next in order and making the several spaces from D to C of the pattern, respectively, equal to those along T S of the other pattern. When the point 5 of the pattern of the boot has been reached, take the distance 5″ B′ of the diagram of triangles as a radius and from 5 of the pattern as center describe an arc, which, cut with another struck from A of the pattern as center with a radius equal to B A of the elevation. The intersection of the two arcs will locate the point B of the pattern, which becomes a center from which to describe those arcs between 5 and C of the pattern the radii of which are respectively equal, to B′ 6′, B′ 7′, B′ 8′ and B′ 9′. It remains now only to add the triangular space shown by F B C of the plan, the true central measurement of which is shown by B C of the elevation. Therefore, with this distance as a radius and C of the pattern as center, describe an arc which intersect with another arc struck from B of the pattern as center, with a radius equal to B F of the plan. This completes the half pattern. If it is desired to make the entire pattern in one piece, describe an arc from C as center with C B as radius, and intersect the same with an arc drawn from B as center with a radius equal to two times B F. This will locate point B on the opposite side of the pattern not shown in the illustration. If it is desired to obtain the entire pattern in one piece by development it may be most economically accomplished by first laying out this last named triangle (B C B) then conducting the work in a reverse order to that above described, working from C toward D and carrying both sides along together. Other methods of duplication may, however, be deemed more expedient.

The pattern for the rectangular pipe above is of so simple a nature as scarcely to require explanation. One-half of it corresponding to F B A E of the plan is shown in dotted lines in the upper part of the engraving, in which *f* B A *g* shows its mitered end.

PATTERN FOR OFFSET BOOT, ROUND TO OVAL

A view of a finished offset boot such as would be used in heating and ventilating piping is shown in Fig. 207. The development of the top and bottom pipes

of the boot is done by the usual method, but the pattern for the center piece will be obtained by triangulation without using the plan for obtaining the basis of the sections and without finding the true sections on the miter lines 1′ 5′ and 6′ 10′ in Fig. 208, as is usually done.

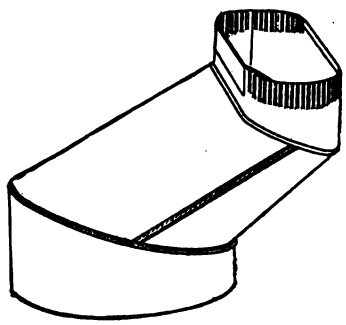


Fig. 207. View of Finished Offset Boot.

Draw the elevation of the boot, as shown by A B C D, establishing at pleasure the miter lines 1′ 5′ and 6′ 10′. Below the elevation the plan view F E 10 is drawn, which, however, is not necessary, it only being here shown to indicate that the halves of the boot on both sides of the line *c d* are symmetrical. Place the profile of the round pipe below D C and divide it into equal spaces, as shown, from 6 to 10 on both sides. In similar manner place the profile of the oblong pipe above A B, and also divide the semicircles at the ends into the same number of spaces as the semicircles below C D, as shown from 1 to 5 in the oblong profile, and through the center of which draw the line *a b*. From the various intersections in the round and oblong profiles draw vertical lines intersecting the miter lines 6′ 10′ and 1′ 5′, respectively, as shown.

Take the stretchout of the round pipe and place it on the horizontal line C H, as shown. Draw the usual measuring lines, which intersect by lines drawn from the various intersections 6′ to 10′ parallel to C H, resulting in the intersections 6″ to 10″ to 6″. C I J H is then the pattern for the round pipe.

The pattern for the oblong pipe is obtained by taking the stretchout of the oblong pipe and placing it on B K and proceeding as before. B L M K is the desired pattern. Bisect 1 1 in the pattern P and obtain *e*, which will be used in developing the center piece. From the various intersections on the miter lines connect lines, as shown, from 1′ to 9′ to 2′ to 8′ to 3′ to 7′ to 4′ to 6′. These lines represent the bases of sections which will be constructed, with altitudes shown in the two profiles of the pipes. For example, to find the true length of 2′ 9′ in elevation, take this distance and place it as shown by 9 2 in the diagram of sections. From 9 and 2 erect the altitudes 9 9′ and 2 2′, equal respectively to the distances measured from the line *c d* in plan to the point 9 and from the line *a b* in the oblong profile to the point 2. The distance from 2′ to 9′ in R is the desired length. In this manner all of the true lengths shown in R are obtained.

The pattern for the transition piece is developed as follows: Assuming that the seam is to come on 5′ 6′ in elevation, take the distance of 1′ 10′ and place it as show by *e* 10 in Fig. 209. With *e* 1 in the pattern P, in Fig. 208, as radius, and *e* in Fig. 209, as center, describe the arc 1, which intersect by an arc struck from 10

as center and 10 1′ in the diagram R in Fig. 208 as radius. With 10″ 9″ in the pattern O as radius, and with 10 in Fig. 209 as center, describe the arc 9, which intersect by an arc struck from 1 as center and 1′ 9′ in the diagram R in Fig. 208 as radius.

With 1″ 2″ in the pattern P as radius, and 1 in Fig. 209 as center, describe the arc 2, which intersect by an arc struck from 9 as center and 9′ 2′ in diagram R in Fig. 208 as radius. Proceed in this manner: Using alternately first the divisions

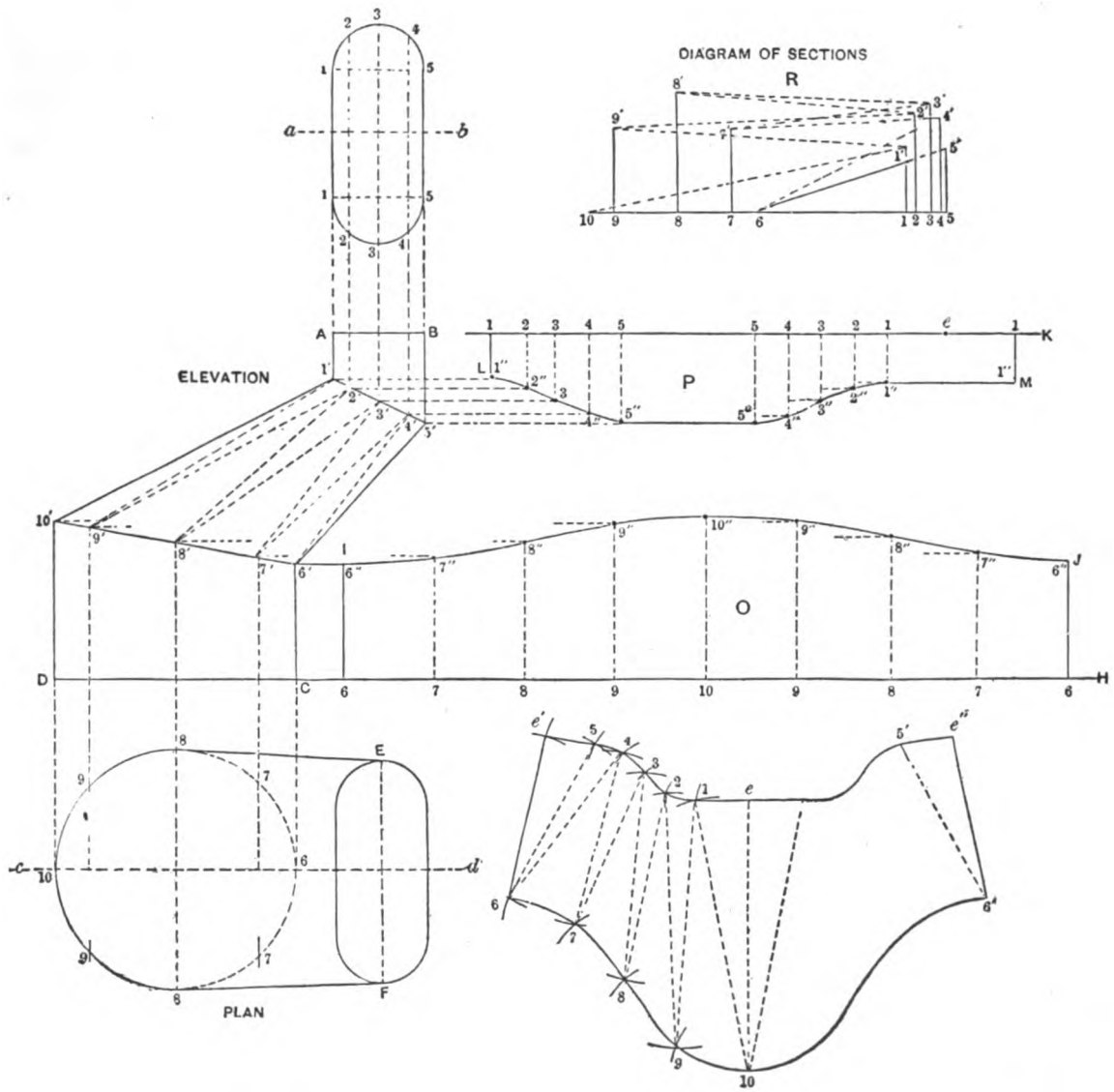


Fig. 208. Plan, Elevation, Diagram of Sections and Patterns Fig. 209. Pattern for Transition Piece

along the miter, cut I J in the pattern O, then the true length in R; the divisions along the miter cut L M in the pattern P, and again the proper length in R, until

the line 5 6 in Fig. 209 has been obtained. Then 5 e' and e' 6 represent respectively the lengths in Fig. 208 shown by e 1 in the pattern P and 5′ 6′ in elevation. Allowance must be made in the pattern for seaming.

PATTERNS FOR STOVE PIPE CONNECTION

The subjoined article is in answer to a request for patterns for an interesting stove pipe elbow. The stipulation was that the stove be connected with the fireboard and, if possible, that the connection should have a flat place where it leaves the stove, so it could be used for a variety of purposes. At the fireplace the thimble is 6 in. and the collar on the top of the stove is equivalent to a 6-in. pipe flattened out to an oval.

In Fig. 210 is presented a reproduction of the sketch as submitted, in which all conditions and dimensions are carefully shown, with the exception that details are omitted from that part of the pipe immediately connected with the stove and for which the patterns are desired. The problem presented therein contains conditions somewhat novel even in the line of sheet metal work. The part in question, the horizontal portion, must be so constructed as to form a joint at one end (the right in Fig. 210) with a short piece of pipe, the profile of which is that of the collar on the stove, while its other end must form a joint or miter with the round pipe which descends obliquely at the back of the stove. Such pieces are by no means uncommon, but the general shape is that which naturally results from the transition from one profile to the other.

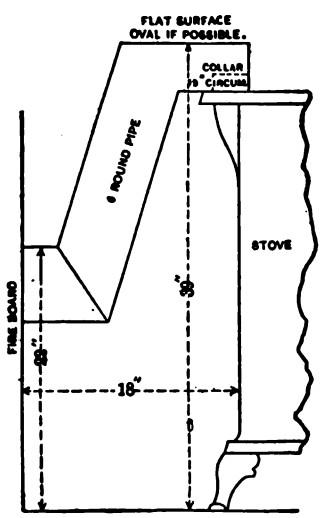


Fig. 210. Stove Pipe Connection as Desired

It is specified that the top surface of this section of the pipe shall be flat and (referring now to the legend on the drawing, Fig. 210) oval if possible. One may pause for a moment to remark that it seems to be a universal error to use the word "oval" when "elliptical" is meant. An ellipse is a symmetrical figure—that is, when divided by either its longer or its shorter diameter both halves are exactly the same, which is not true of the oval when divided by its shorter diameter. In other words, the word "oval" signifies egg shaped. It is presumed, however, that the simplest method of solution which will give the desired flat surface on top will be

satisfactory without reference to its exact shape. It is therefore shown how the given shapes of the several parts may be utilized to produce the nearest approximation to an "oval" top which they are capable of, maintaining at the same time a uniform capacity throughout the course of the pipe so far as possible.

Begin the work by the construction of a plan and an elevation of the several parts of the pipe as shown in Fig. 211, which is drawn to a scale of 2 in. to the foot. Working drawings must, of course, be made full size, so that the patterns when obtained can be transferred at once to the metal and cut. The general outlines of these two views as given in Fig. 211 can therefore be redrawn full sizes—that is, each dimension multiplied by six—after which the subsequent operations can be conducted as explained herein.

In beginning the drawings, the hight B C should be somewhat more than the width across the collar at its widest part, plus the hight of the collar above the stove, so that the capacity of the elbow may not be reduced in the least. From B draw B A horizontally to meet the outer line of the inclined pipe at A. Before going further with the elevation, begin a plan by carrying the points A, B and D upward to cut a center line drawn horizontally, as shown at A′, B′ and D′. Now bisect D′ B′, draw the vertical center line G H of the collar and complete the plan or profile of the collar, which becomes the profile of the vertical pipe E D C B of the elevation. This profile must, of course, be made to correspond exactly with that upon the stove. In Fig. 211 it has, for simplicity, been made to consist of two semicircles the centers of which are at *c* and *d*, joined by straight lines. In many cases the sides of the profile are somewhat curved instead of straight.

In providing for the required flat surface on the top of the pipe, the line A B of the elevation can be assumed as an edge view of such surface, while its outline or shape must be determined upon the plan. To assist in this operation, suppose for the time being that the inclined portion of the pipe is continued up to intersect with the plane A B, as shown at the points A and *e*. Since now the plane represented by the line A *e* is oblique to the sides of the pipe, A K and F L, a section through the pipe on this line will be an ellipse with a major axis A *e* and minor axis equal to the diameter of the pipe as shown in the profile below. This ellipse if represented upon the plan would pass through the points A′ and *e*′. In consideration of the fact that, in the present case, the line A *e* is a very little greater than the diameter of the pipe and that only a portion of the section will be used, it will answer all purposes to set off from A′, on A′ B′ of the plan, a distance equal to the radius of profile S, as shown at *f*, and from *f* as a center draw somewhat more than half a circle, as shown. Lines drawn tangent to the circle

just drawn and to the circles the centers of which are at *c* and *d*, all as shown by *a*″ H and *a*′ G, will complete the outlines of what may be made a flat surface. To the several curves and sides of this surface patterns to form a satisfactory elbow can be made to meet without difficulty.

The surface A′ *a*″ H B′ G *a*′, while neither an ellipse nor an oval, more nearly approximates the latter. Two other methods of solving the problem are possible. By one method the flat service on top can be made a true ellipse, or even a figure of any shape, while by the other method the shape will be that of the common approximation to an ellipse consisting of arcs of circles; but both methods will be more complicated than that herein shown. As the shape just obtained in Fig. 211 includes the entire space within the outlines of the plan, which an ellipse would not, it is presumed that the shape there shown will be more acceptable than if the letter of the request had been complied with, because of the greater area thus obtained. Therefore, it will be shown how the remaining parts of the elbow may be laid out.

From points *a*′ and *b*′ of the plan, drop lines cutting A B of the elevation as shown at *a* and *b*. Since the point E has already been fixed as the throat of this part of the elbow, draw a line from E to *b*, constituting the miter line between that part of the pipe which fits over the stove collar and the intermediate or transitional piece. In locating the point F, the throat of the second elbow, it is necessary to place it just low enough that the area of a vertical section through the pipe at F *g*″, and indicated by *g g*′ of the plan, is equal to that of the round pipe; at least it should be no smaller than that of the smallest part of the pipe, which is in reality at the collar of the stove. This is simply a matter of figures. If it is assumed that 5 in. is a proper distance below the line A B to place the point F, it can be seen by comparison that the area of the vertical section above mentioned is about equal to that of the profile of the round pipe. In the diagram in the lower left hand corner of Fig. 211, F *g g*′ is a section on F *g*′ of the plan and elevation, while the circle is the same as that of the profile S. Therefore draw F *a*, representing the miter line of the second elbow, and F E, the bottom line of the transitional piece, thus completing the elevation.

For the pattern of the inclined pipe, first divide its profile, S, into any convenient number of equal spaces, as shown by the small figures, and from the points thus obtained project lines parallel to A K to cut the lines A *a* and *a* F as shown. Since both halves of the pattern will be the same, one half of the profile may be used for both halves of the pattern. Inasmuch as neither of the points in the profile strikes the point *a*, the intersection of the two miter planes, this point *a*

must be carried back to the profile as shown, where it is also marked *a*. The several spaces in the profile must now be set off on any straight line, as M N, drawn at right angles to the lines of the pipe and numbered accordingly, thus constituting what is termed a stretchout of the profile, one half of which only is shown in the drawing. From the several points on M N measuring lines are drawn parallel to A K, extending somewhat beyond a point opposite the miter to be made. Now from each of the points previously obtained on the miter lines project lines at right angles to A K, to cut measuring lines of corresponding number. A line traced through the points of intersection will give the required pattern, one half of which is shown by Q R P.

The method of developing the pattern for the vertical pipe is exactly similar to that just described. One half of its profile is shown by D′ G B′, the curved portion of which is divided into equal spaces, and the entire stretchout should be set off on the line A B of the elevation extended and numbered correspondingly, one half as before being shown. Only a portion of this profile miters against the oblique plane E *b*, and, as before, the point *b′* must be carried back into the profile and properly located in the stretchout, as shown by *b′*. A portion only of the points is included in the miter, the remainder being required to obtain the exact length of the stretchout. The projection of the points from the plan against the miter plane E *b* and thence into the stretchout is clearly shown.

The pattern for the intermediate section of the elbow, which, it will be observed, is irregular in shape, is obtained by triangulation, which consists in dividing its surface into triangles and then obtaining the true lengths of the several sides of each by a system of diagrams. In these operations it will be convenient to use the points along the two miter lines F *a* and E *b*, obtained in developing the previous patterns. With this part of the work in view, therefore, the profiles S and D′ G B′ should be so divided at the outset that those portions of the two miters which are to be connected by the transition piece shall each contain the same number of spaces. Thus in one half of the miter, F *a*, there are five spaces, which is also true of the miter E *b*, remembering that the point D′ is exactly behind the point 8, as shown upon the plan. The method of procedure is to first connect points of like number in the two miters by a system of lines, and then to divide the four-sided figures thus produced by another system of lines diagonally, the latter system being dotted simply for distinction, thus cutting the entire surface of the part to be developed into small triangles. The triangulation may be indicated either upon the plan or the elevation, according to the nature of the subject. It is sometimes advisable to show it upon both views, in order to determine which view will best

serve the purpose of obtaining subsequent measurements. In the present instance the plan is used for this purpose.

Before beginning this work, however, it will be necessary to obtain a view of the miter *a* F in the plan. This can be accomplished in the following manner: Project lines from all the numbered points in *a F* vertically into the plan, cutting the center line A′ B′, as shown, between *f* and F′, and on each vertical line set off from the center line the length of lines of corresponding number in the profile

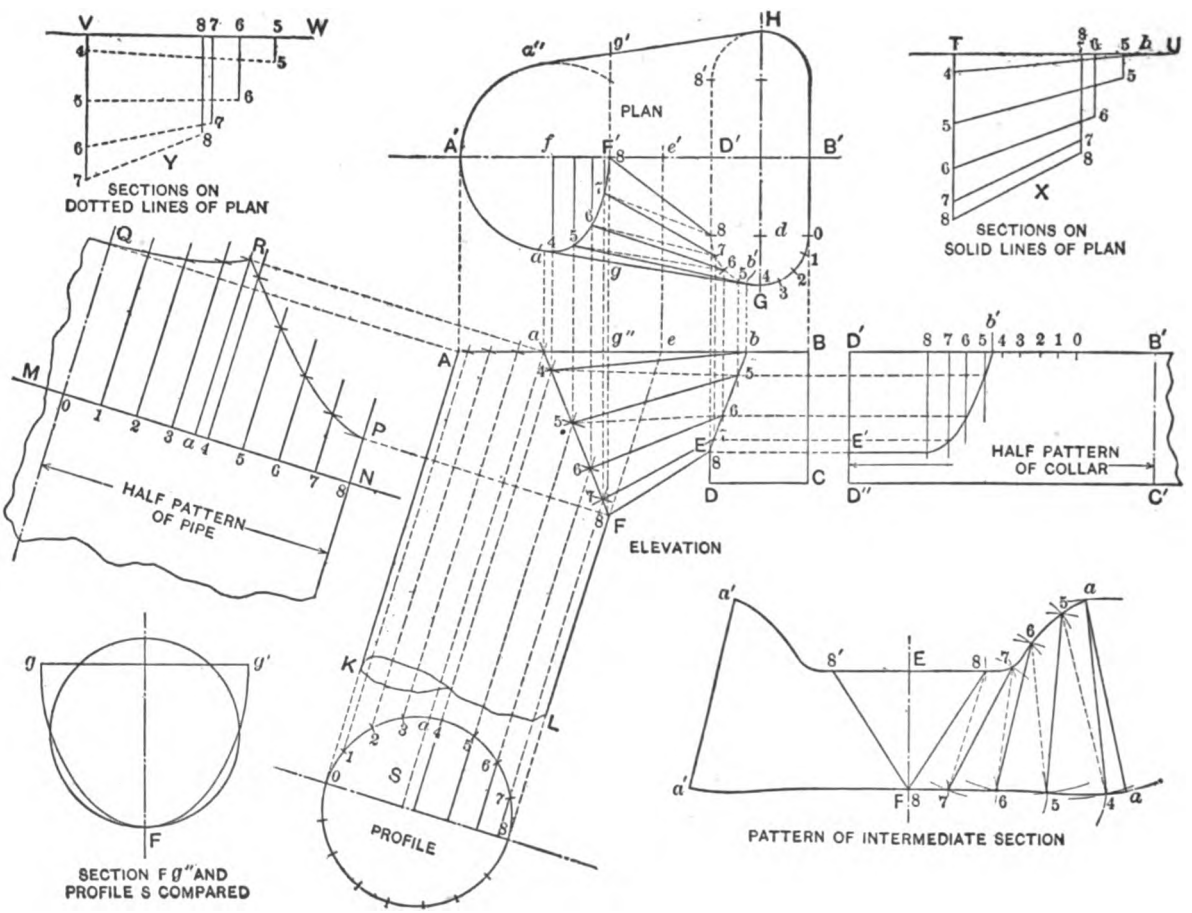


Fig. 211. Design for Elbow and Method of Developing Patterns for It

S as measured from its center. A line traced through the points of intersection, as shown from *a′* to F′ of the plan, will give the required view. Now connect points of corresponding numbers in the two miters by solid lines, as shown by 8 8, 7 7, etc., and draw dotted lines connecting diagonally opposite points, so as to obtain the shorter diagonal. Thus a line connecting 7 of the miter *a′* F′ with 8 of the plan of the collar is shorter than a line drawn from 8 at the left to 7 at the collar. Follow the same order throughout the piece, connecting 6 with 7, 5 with 6, etc.,

as shown. Had the side lines of the stove collar been drawn curved, as mentioned before, it would be necessary to add one or two more points in this curve between 8 and D′, from which solid lines could have been drawn to point F′ of the other miter. In obtaining the true lengths of the several solid and dotted lines of the plan, it will be seen that the horizontal distance between any two connected points can be measured upon the plan, while the difference in vertical distance between the same two points can be obtained from the elevation.

Therefore, to obtain the true lengths of the solid lines of the plan, construct the diagram shown in the upper right hand corner of Fig. 211, marked X. First set off their several lengths from T on the horizontal line T U, as shown by the small figures near U. From T and from each of the numbered points drop vertical lines, as shown. Upon the line from T set off the hights of the numbered points in *a* F as measured vertically to the line A B, numbering each point correspondingly. Upon each of the other vertical lines near U set off the vertical hight of the point of corresponding number in E *b*. Now connect points thus obtained with points of corresponding number on line T. The several lines, 4 *b*, 5 5, etc., will then represent the true lengths of the corresponding lines of the plan of elevation.

The true lengths of the dotted lines of the plan are obtained in exactly the same manner, all as shown by diagram Y at the left. Having now obtained the true lengths of all the long sides of the triangles, find the lengths of their short sides or bases in the edges of the two miter patterns first obtained. Thus the true distances, *a* to 4, 4 to 5, etc., of the left end of the pattern of the transition piece are found between R and P of the pattern of the oblique pipe, while the true lengths of the spaces *b* to 5, 5 to 6, etc., for the end adjoining the collar are found between E′ and *b*′ in the pattern for the collar piece.

It simply remains now to construct the several triangles indicated upon the plan one after another in their proper sequence. Therefore, the work can be begun most advantageously by constructing the triangle indicated by 8 F′ 8 of the plan, viz: Upon any line as a center line, as F E below the elevation, set off the length F E of the elevation, and through the point E draw a line at right angles, upon which set off in either direction from E the distance D′ 8 of the plan, as shown by 8′ and 8, and draw the lines F 8 and F 8′. The same result may be obtained by first drawing the line 8′ 8, making it equal to 8′ 8 of the plan; then with the distance 8 8 of the diagram X as radius and the points 8′ and 8 of the pattern as centers, strike two arcs, intersecting at F. Proceed now to add to one side of this the triangle indicated by F′ 7 8 of the plan, viz: With the distance 8 7 of the diagram Y as a radius and the point 8 in the upper edge of the pattern as center,

strike a short arc near F, which intersect with another arc struck from F as center, with a radius F′ 7 of the miter pattern of the oblique pipe, thus establishing the point 7 in the lower side of the pattern. Now, with 7 7 of diagram X as radius, and point 7 of pattern just obtained as center, strike a short arc, which intersect with another arc, its center being 8 in the upper side of the pattern, and its radius is the distance 8 7 of the miter pattern of the pipe to fit the collar, thus establishing the point 7 in the upper side of the pattern. Proceed in this manner, using as radii the distances obtained in diagram Y in connection with those on the edge of the pattern of the oblique pipe in obtaining the points along the lower side of the pattern, and the distances in diagram X with the spaces on the edge of the pattern of the collar piece in obtaining the points in the upper edge of the pattern, until all the distances have been used and the line *a a* is reached, which will complete one half the pattern. That part of the pattern shown by *a* 8 8 *a* can be transferred by any convenient means to a reverse position at the left of the first large triangle, thus completing the entire pattern. It is understood that the necessary edges or laps required to make the usual form of joints must be added to all of the patterns; the pattern here shown being net.

RISES FOR ELBOWS

The rise in an elbow is equal to the difference in length between the longest side and the shortest side of an end piece. In the accompanying illustration, Fig. 212, showing a three-piece elbow, the distance A B is the rise. The following are the rises of elbows of from 3 to 10 pieces, the diameters of which are 1 inch:

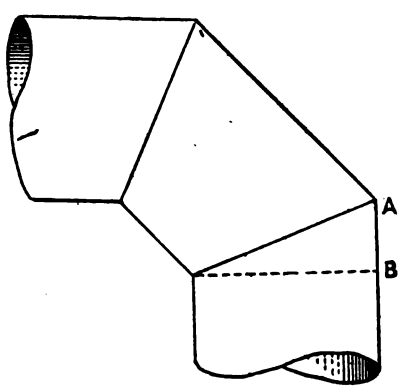


Fig. 212. Rises for Elbows

3	piece	elbow,	0.414	inch	rise.	7	piece	elbow,	0.132	inch	rise
4	"	"	0.268	"	"	8	"	"	0.113	"	"
5	"	"	0.199	"	"	9	"	"	0.098	"	"
6	"	"	0.158	"	"	10	"	"	0.087	"	"

FRACTIONAL EQUIVALENTS (Correct to 1-64 of an Inch)

0.414	13-32	0.132	9-64
0.268	17-64	0.113	7-64
0.199	3-16	0.098	3-32
0.158	5-32	0.087	5-64

To find the rise for an elbow of any diameter multiply the rise given in the above table by the diameter in inches of the desired elbow, and the result will be the rise in inches for the desired elbow. Thus, to find the rise for a seven-piece

elbow the diameter of which is 11 inches, multiply 0.132 by 11, which will give 1.452 inches, the desired rise.

THE PERFECT ELBOW PATTERN

All tin and sheet iron workers who have had experience in making elbows for round pipe know the trouble there is in trimming the pieces for the elbows, especially if they have a quantity to put together. Even a miter pattern developed by a system of lines in the ordinary way needs to be trimmed to meet the requirement of a seam. A perfect pattern requires that proper allowance shall be made for the "take up of the seam," as it is called.

The object of the diagrams, Fig. 213, and the accompanying explanations, is to show how a correct and reliable pattern can be obtained that will require no trimming of the work afterward. Solid lines in Fig. 213 show profile of a square elbow. A B is the miter or angle line of the profile. The dotted lines A C and A D show the correct miter line required in an elbow with the usual seamed joint. To determine the points C and D first extend the line E B sufficiently to make the distance from B to C 1-16 inch longer than the width of seam required, as the seam naturally works a little large. The seam for this purpose being usually made in the small, thick edge machine, set the gauge the required width for the seam, from ⅛ to 3-16 inch, as the case may be. If the seam is ⅛ inch wide then make the distance from B to C 1-16 inch more, or 3-16 inch; if the gauge is set for a seam 3-16 inch wide, then make the distance from B to C, ¼ inch. The distance from B to D on line B E is always the same as the distance from B to C. This is what would be termed adjusting the miter line to meet the requirements of the seam. Having established these miter lines A C and A D, proceed to develop a pattern from them the same way as from the miter line A B of the profile.

On the plan of the pipe, as shown, space off on the circle 1, 2, 3, etc., up to 9, as in this case, equal to one half the circle or size of pipe. From these points 1, 2, 3, etc., and at right angle with the base line E F, draw lines to intersect with miter lines A C and A D. Then draw a line, as K L, shown to the left, level with the base line E F . On this stretchout line K L space off the distance 1, 2, 3, etc., up to 9, the same as in the plan, then duplicate the numbers, except 9, and this gives the stretchout or circumference of the pipe. From these points 1, 2, 3, etc., on line K L, and at right angles with it, draw lines of sufficient length to intersect lines drawn at right angles with these lines from corresponding points 1, 2, 3, etc.,

on miter line A C and A D. The intersecting points of these lines, after connecting them, give the miter lines, *a d* and *e h*, that are required, all as shown in the diagram, Fig. 213.

a b c d is the developed pattern for that half of the elbow represented by A F E D. The developed pattern, *e f g h* , is for that half of the elbow represented by A F E C. The end lines of the pattern, 1 at *c* and 1 at *b*, are to be of sufficient length to form the width of pattern required usually calculated to cut from stock material without waste. In order to have a guide to go by in putting the two pieces together, to make the elbow true and free from twist or wind, make a prick mark in the center of the pattern *e f g h* about ½ inch from the miter line, as shown by *k*. Then, when putting the pieces together, place this dotted point, as shown by *k*, exactly in line with the seam of the opposite piece, if the seam is a lapped seam—that is if the horizontal seam of the pipe is a lapped seam. But if the seam (horizontal) of the pipe is a locked or grooved seam, then place this dotted point in line with the center of the seam, which varies in width from ¼ to ½ inch, more or less.

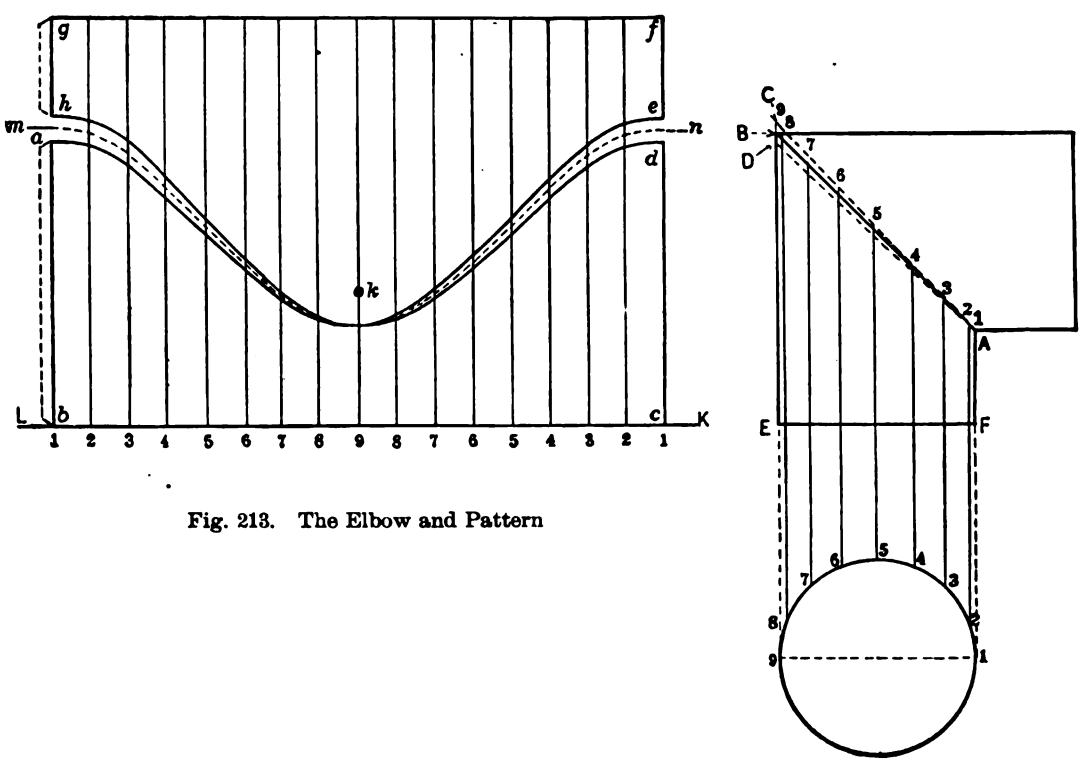


Fig. 213. The Elbow and Pattern

This method of securing a perfect pattern applies alike to elbows made to any angle or bevel, as the same width of seam, or lock, is used in both cases of square and beveled miters. If the pipe is to have simply a lapped joint, one piece lap-

ping over the other, then add the width of lap at one end of the developed pattern as shown to the left of the pattern in Fig. 213.

If it is to be a seam that has edges turned and grooved together, then divide the lap required for making the seam equally between each end of the pattern. The dotted line *m n* between the solid miter lines *a d* and *e h*, shows the developed pattern from miter line A B in the profile. It also shows what has to be cut away to meet the requirements of the seam when such a pattern development is used.

SEAMS IN AIR DUCTS

A popular method of seaming elbows and rectangular pipes is by use of what is often termed the "Pittsburg" seam. A section of an elbow taken on the line A B of Fig. 214 is as shown in Fig. 215 with the seam exaggerated in size. The sides or cheeks of the elbow have a ¼-in. edge allowed, which is bent out square, usually with a mallet and dolly, and would be as shown in Fig. 216. The back and throat of the elbow have ⅞ in. allowed and are bent as shown in Fig. 217. This pocket edge is placed on the back and throat because it would be impossible to form it on the circular part of the sides—whereas on the back it is bent in the brake, while the back is flat and then rolled to shape. During the rolling operation a heavy strip of metal is placed in the pocket so that the rolls will not squeeze the pocket tight. The edge of the side is slipped into this pocket when assembling the elbow and to keep it in the pocket the upstanding edge *a* of Fig. 217 is hammered over as at *d* in Fig. 215. The idea of the shoulder or depression *a* in Fig. 215 is to have a foundation for the impact of the blows of the hammer during the operation of throwing over the edge. Without this a dolly would have to be held on the edge *b*, Fig. 215, to prevent driving it back and distorting at *c*. This depression also makes the pocket seam flush with the outside of the cheek and almost invisible. As no other tools for assembling are required, this seam is commendable in case piping must be shipped in parts from the shop to the building.

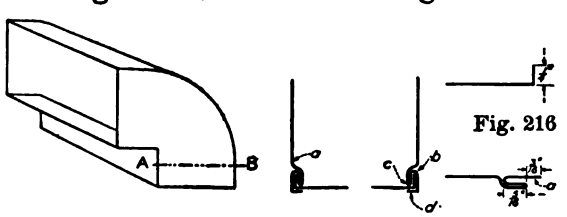


Fig. 214 Fig. 215 Fig. 216 Fig. 217

Details of Making a "Pittsburg" Seam

THREE PIECE ELBOW OVAL TO ROUND

The exemplification of this problem, is by what the author terms a simplified process, dealing with triangulated articles that have two symmetrical halves.

Referring to Fig. 218, first draw the side elevation of the elbow of the required size and angle and in its proper position outside of the top and bottom openings

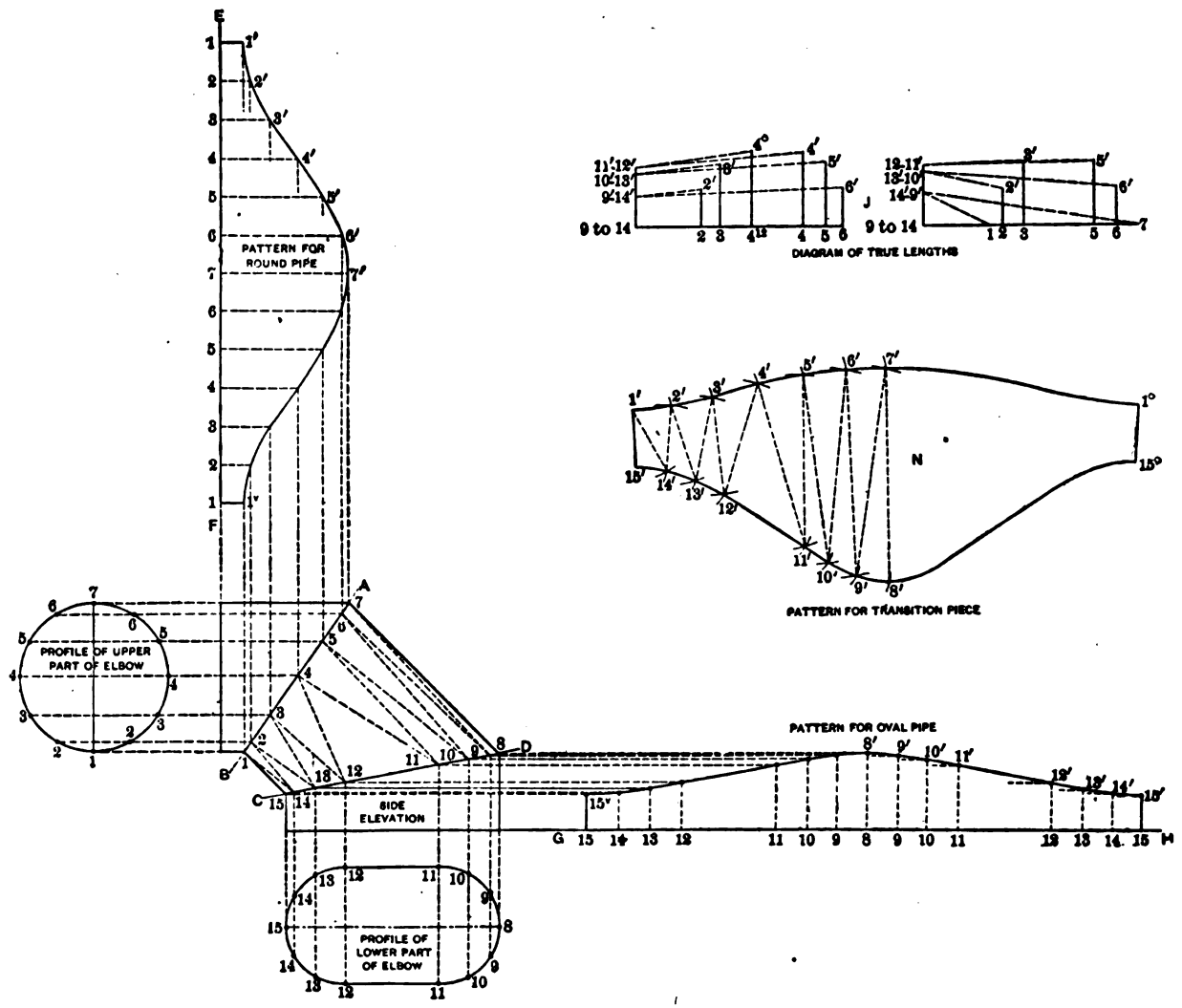

PATTERN FOR ROUND PIPE
PROFILE OF UPPER PART OF ELBOW
SIDE ELEVATION
PROFILE OF LOWER PART OF ELBOW
DIAGRAM OF TRUE LENGTHS
PATTERN FOR TRANSITION PIECE
PATTERN FOR OVAL PIPE

Fig. 218. The Procedure of Obtaining Patterns

draw the profile of the round and elliptical pipes as shown. Draw the miter lines A B and C D.

To obtain the pattern for the upper part of the elbow, divide the circular profile into equal spaces as shown from 1 to 7, from which points draw horizontal lines until they cut the miter line A B as shown by similar numbers. Perpendicular to

these lines draw the line E F, upon which place the girth of the circular profile as shown from 1 to 7 to 1. From these points horizontal lines are drawn and intersected by perpendicular lines erected from similar numbered intersections on the miter line A B. A line traced through points thus obtained, as shown from 1′ to 7′ to 1ᵛ will be the desired miter cut and 1 1′ 1ᵛ 1 will be the pattern for the upper arm of the elbow.

In a similar manner obtain the pattern for the lower arm. Divide the elliptical profile into equal spaces as shown from 8 to 15 and carry up vertical lines until they intersect the miter line C D as shown by similar numbers. In line with the lower arm draw the girth line G H, upon which place the girth of the elliptical profile as shown by similar numbers. At right angles to G H from the various points of intersections, erect vertical lines, which intersect by lines drawn parallel to G H from similar numbered intersections on the miter line C D. A line traced through points thus obtained as shown by 15 15′ 8′ 15ᵛ 15 will be the desired pattern. To obtain the pattern for the middle piece of the elbow, a set of true lengths must first be obtained as follows: Connect the various points on the miter lines A B and C D as shown. These lines represent the bases of sections which will be constructed, the altitudes of which are equal to the various hights in the semi-profiles of the two arms of the elbow.

For example: To obtain the true length of the line 11 4 in the side elevation, take this distance and place it as shown from 11 to 4, to the left in diagram J. From the points 11 and 4 in J, erect vertical lines making 11 11′ and 4 4′ equal respectively to the distance measured from the center line 1 7 to the point 4 in the round profile, and the distance measured from the center line 8 15 to the point 11 in the elliptical profile. A line drawn from 4′ to 11′ in J will be the true length of 4 11 in the side elevation. In this manner obtain the true lengths of all the dotted lines shown in the middle section in the side elevation, as indicated in the two diagrams in J. These true lengths having been found and as the miter cuts in both the pipe patterns give the true edge lines, the transition or middle piece is found as follows: Take the length of 7 8 in the side elevation and place it as shown by 7′ 8′ in N. With the distance from 8′ to 9′ in the miter pattern of the oval pipe as radius, and 8′ in N as center, describe the arc 9′, which intersect by an arc struck from 7′ as center and 7 9′ in diagram J as radius. Again, using 7′ 6′ in the miter pattern for round pipe as radius, and 7′ in N as center, draw the arc 6′, which intersect by an arc struck from 9′ as center and 9′ 6′ in diagram J as radius. Proceed in this manner, using alternately first the division in the miter pattern for oval pipe, then the proper true length in J; the division in the miter pattern for round pipe,

then the true length in J until the last line 1′ 15′ in N has been obtained, and which is equal to 1 15 in the side elevation.

It will be noticed that after the line 4′ 12′ in N has been obtained the pattern is continued from this line, by first using the division on the miter pattern for round pipe, etc. A line traced through points of intersections thus obtained will be the half pattern as shown by 1′ 7′ 8′ 15′. If the full pattern is desired, reverse on the line 7′ 8′ as shown by 7′ 1° 15° 8′.